CLIMATOLOGY OF IOWA SERIES NO. 2, REVISED

Iowa Department of Agriculture and Land Stewardship
State Climatology Office

IOWA PRECIPITATION FREQUENCIES

by Paul Waite

Iowa Department of Agriculture and Land Stewardship

Dale M. Cochran.....Secretary
Shirley Danskin-White.....Deputy Secretary

Des Moines, Iowa
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FOREWORD

The Iowa Rainfall Frequencies (1980) went out of print in 1987, but the continuing number of requests for the publication necessitated the reprinting with its minor revisions.

The need for precipitation recurrence rates and the applications for probability planning is necessary for soil erosion control, reservoir design or waterways management. The data are often used for many out-of-door events planning which encompass that for community events, the State Fair dates, the National Balloon Races dates and many, many more.

The revisions in this issuance include the annual and crop season maps drawn to the 1951-80 normals, but the statewide figure depicting average monthly precipitation for the 1941-70 period remains in place because it is believed to be the better profile of the long term precipitation and likely that of the future as well. The figures on page 5 depict the precipitation from 1873 through 1984 as annual amounts and in the lower figure as 10 year running means which portray the longer term wet and dry patterns. The very wet 10-year running means since 1984 include the record wettest of 35.45 inches average for the period 1977-86. The 1976-85 decade averaged 33.79 inches and the 1978-87 decade averaged 35.10 inches. Thus, the importance of studies about the precipitation variability in Iowa as prepared in the referenced Climate Series No. 7, Iowa Precipitation Variations: Past, Present and Future from which page 5 was obtained. Long term climatic planning need to take into account the highly probable turn to the much drier regime in the 1990's along with the probable warm-up.

Precipitation records although available in Iowa since 1836 were primarily utilized from the 20th Century for the data presentation in this publication and as such were from a somewhat drier portion of the climatic history of Iowa. Yet, the probability patterns are not changed greatly with other periods as for example those short term data in the referenced No. 6 of the climatic series.

ACKNOWLEDGMENTS

We are deeply indebted to thousands of public spirited Iowans, who, as Cooperative Weather Observers with various federal and state agencies generously provided the basic precipitation data for this publication. Most of the data were provided to the National Weather Service since 1891. Those Iowa precipitation data begun in 1836 are now archived at the State Climatology Office at Des Moines and also at the National Climatic Data Center at Asheville, North Carolina. We are also indebted to the National Weather Service and the Soil Conservation Service for precipitation studies from which a large part of this publication is derived. Since part of those publications are now out of print it is important to Iowan's that the data be assembled and expanded for agricultural and hydrologic planners. The National Climatic Data Center publications also provide basic data from which the normals are prepared for this publication. But most of all it is the dedication and scientific accuracy of the Iowa Weather Observers that has made this and many other publications about Iowa's climate possible to aid us in wisely planning for the future.

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IOWA RAINFALL FREQUENCIES

Rain, including the melted water equivalencies of snow, ice, sleet and hail, is the most observed of all weather elements, because of its areal and temporal variations and its prime importance to our agricultural economy. Precipitation is our primary water resource and agriculture is the greatest water consumer. It is our rainfall anomalies, which cause us our greatest agricultural losses; drought is the most costly, yet flood can be quick and devasting to localized areas. Each takes its toll in terms of crops, soil and property.

Environmentally related decisions are often dependent upon precipitation probabilities. Bridges, dams, sewers and buildings are constructed to withstand certain threshold rainfalls. Soil erosion potential likewise is related to rainfall rates. Planning depends upon the knowledge of rainfall rates as prepared and adapted for Iowa useage. The maps, tables and fiqures following depict in greater detail and/or easier to read formats than certain of the orginal publications, some now out of print.

The average annual and crop season (April through September) precipitation maps are based upon the 1941-70 period. But year to year precipitation is great having varied from 12.11 inches at Clear Lake in 1910 to 74.50 inches at Muscatine in 1851. Averaged on a statewide basis the 1873-1979 variance ranges from 19.89 inches in 1910 to 44.16 inches in 1881. In ten percent of the years the state averages over 37 inches; in the ten percent of the driest years less than 25.25 inches. The annual cycle of statewide precipitation (Figure 2) varies from 1.00 inch in January and February to 5.13 in June. The crop season, averaging 23.11 inches, accounts for 72% of the annual precipitation while the cool half year receives about 8.80 inches of which about 35% falls as snow.

The daily distribution of precipitation provides a trace or more on about half the calendar dates per year. Meaurable precipitation amounts of 0.01 inch or more can be expected over most of the state on slightly more than 100 days per year. At the threshold of 0.10 inch only 50 to 65 days are with such quanities; with half an inch or more the number of days is further reduced to more nearly 20 and one inch or more per day is reduced to only a few per year, most of which occur in the warmer, rainier half year.

The 30 minute to 24 hour rainfalls with selected recurrence periods are adapted from the out of print USDCWB Technical Paper 40. Those maps and the selected tables following indicate certain point values for planners. For those users who desire the probable maximum precipitation (PMP), those are adapted from Hydrometeorological Report No. 51. Two observed areal storm studies for Boyden and Bonaparte are available from the above report and are included at the end of this report.

The out of print USDC WB Technical Paper No. 16 contains monthly and annual maximum 24 hour rainfalls through 1950. Since 1950, those data can be obtained from the monthly Climatological Data, Iowa or from the State Climatology Office.

The greatest 24 hour rainfall measured in Iowa at an official location totaled 12.99 inches at Larrabee (Cherokee County) on June 24, 1891. Some other large 24 hour amounts include the June 10, 1905 rainfalls at the Van Buren County sites of Bonaparte with 12.10 inches, Keosauqua with 11.23 inches and Stockport with 10.63 inches. On September 18, 1926 Sioux Center (Sioux County) reported 11.66 inches.

Some unofficial sites have measured heavier rainfalls and those are documented in the appropriate month of the Climatological Data, Iowa.

One of the greatest rainfalls determined by "bucket survey" was that which fell on Decatur County on the night of August 5-6, 1959 between the hours of 9 p.m. and 6 a.m. with measurements of 16.7 inches and possibly 17.0 inches.

The 16.20 inches measured on July 17, 1968 at Waverly, Iowa is the heaviest unofficial 24 hour rainfall in northern Iowa during recent decades. Shell Rock measured an official 12.40 inches rain in 24 hours during that storm. Some other outstanding storms in recent years include the official 12.53 inches in 24 hours at Audubon which fell in a few hours the night of July 1-2, 1958 across the upper reaches of the East Nisnabotna and Raccoon Rivers. The observer believed that the Audubon rainfall (including that spilled) approximated 13.23 inches.

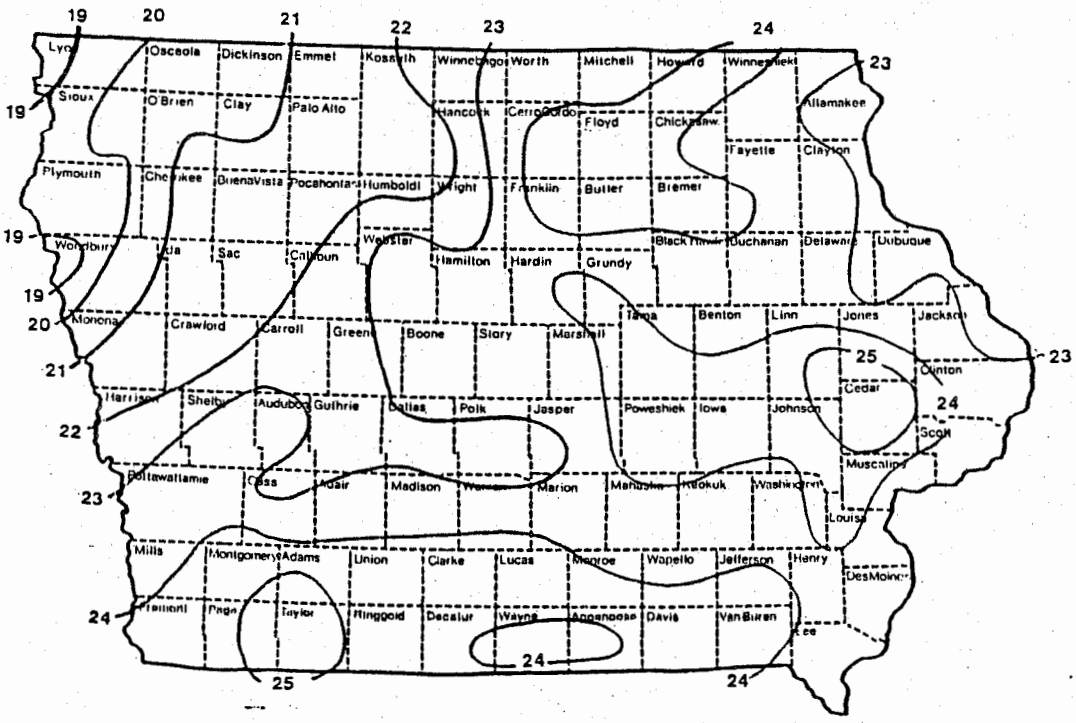
On August 8, 1961, mostly between 8 p.m. and 12 p.m., 10 to 13 inches rain fell a few miles east of Washta; apparently a record rainfall for such a short period with a record high peak discharge per unit area. On August 30-31, 1962 Ida County reported an unofficial 14.5 inch rain and Sac County 12.4 inches in a large area storm. On September 10-12, 1972, as much as 20 inches or more rain fell at Harlan in Shelby County. The heaviest rains extended from Crawford to Adams County.

On July 10, 1955 a World's record one minute rain fell at 11 miles north of Jefferson. The rain averaged 0.69 inch per minute during 1.4 minutes of heavy rainfall.

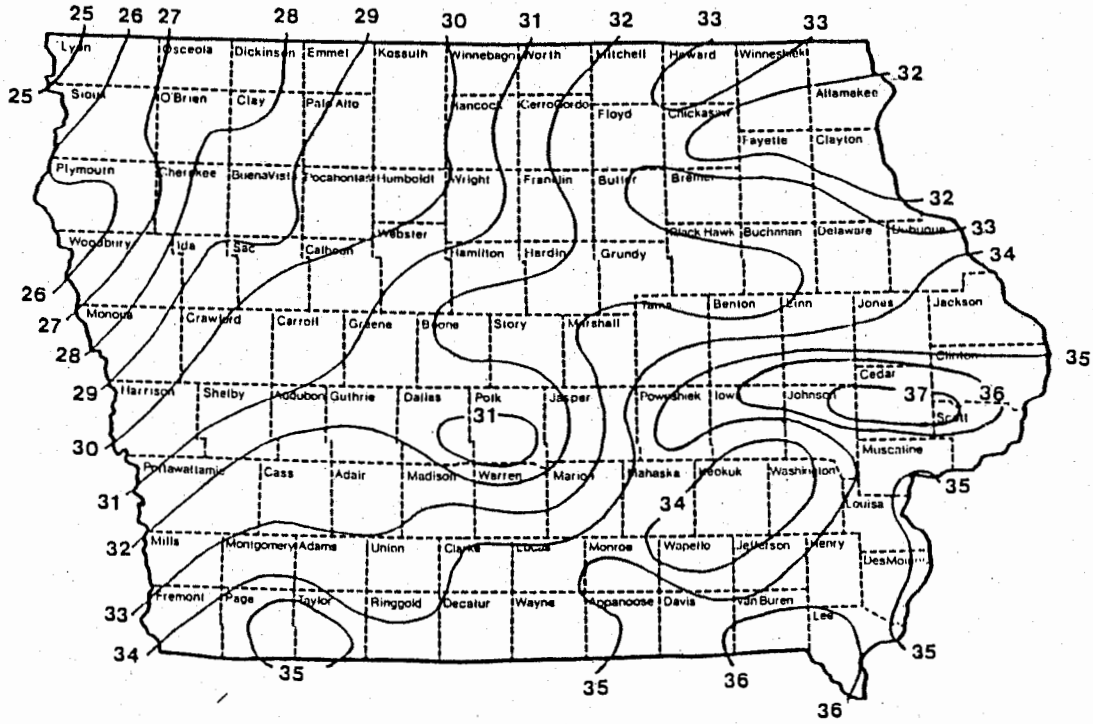
Iowa's wettest month of record, June 1947, averaged 10.33 inches. The second wettest months were September 1965 and September 1926 each averaging 9.66 inches. The wettest month at any single Iowa location was the 22.18 inches rain which fell during June 1967 at Red Oak to exceed the previous record 19.88 inches in June 1891 at Larrabee.

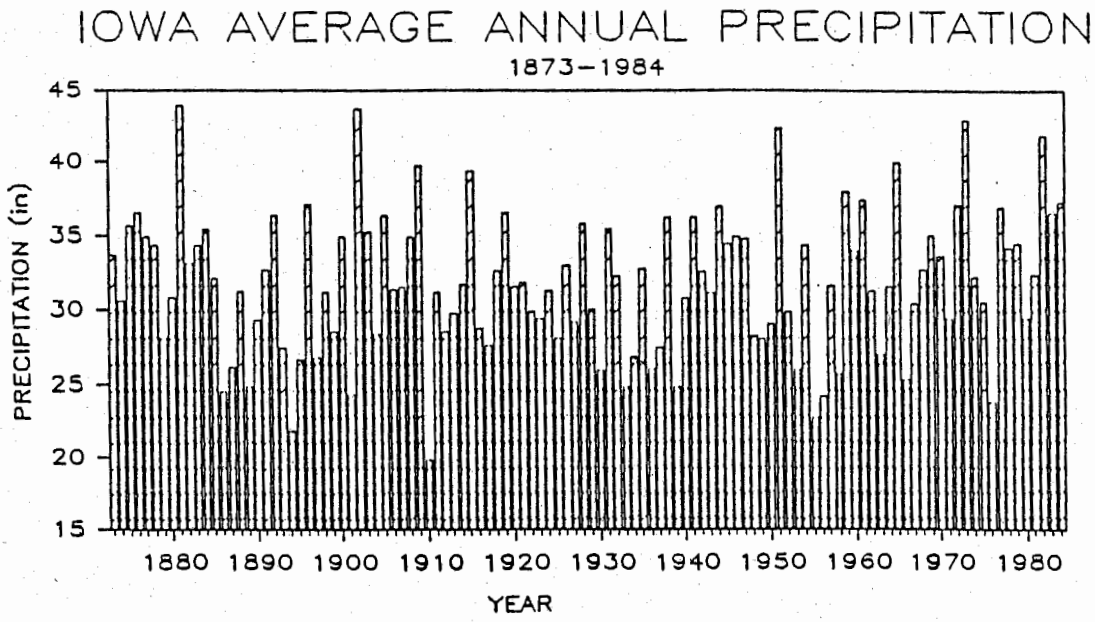
NORMAL CROP SEASON PRECIPITATION, 1951-1980 (inches)

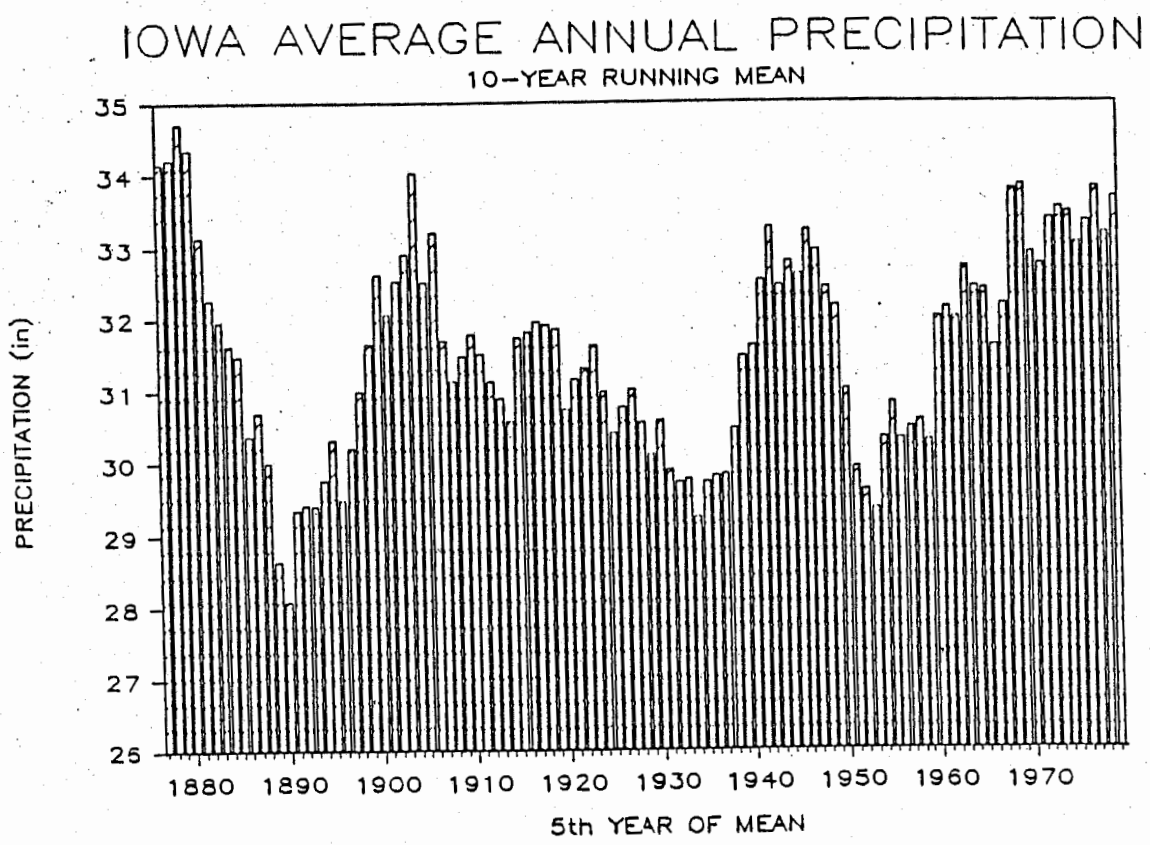
APRIL THROUGH SEPTEMBER

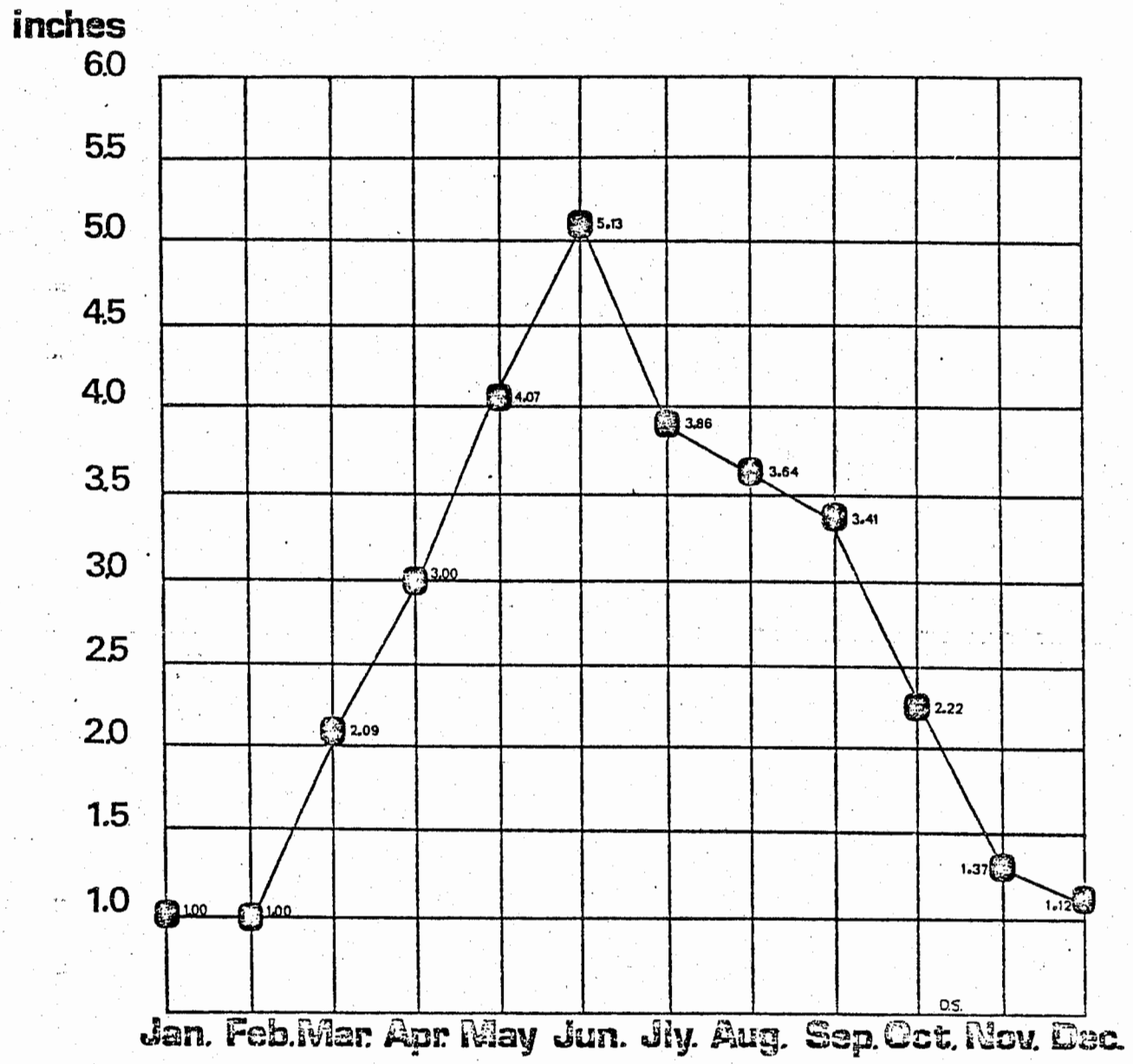


NORMAL ANNUAL PRECIPITATION, 1951-1980 (inches)



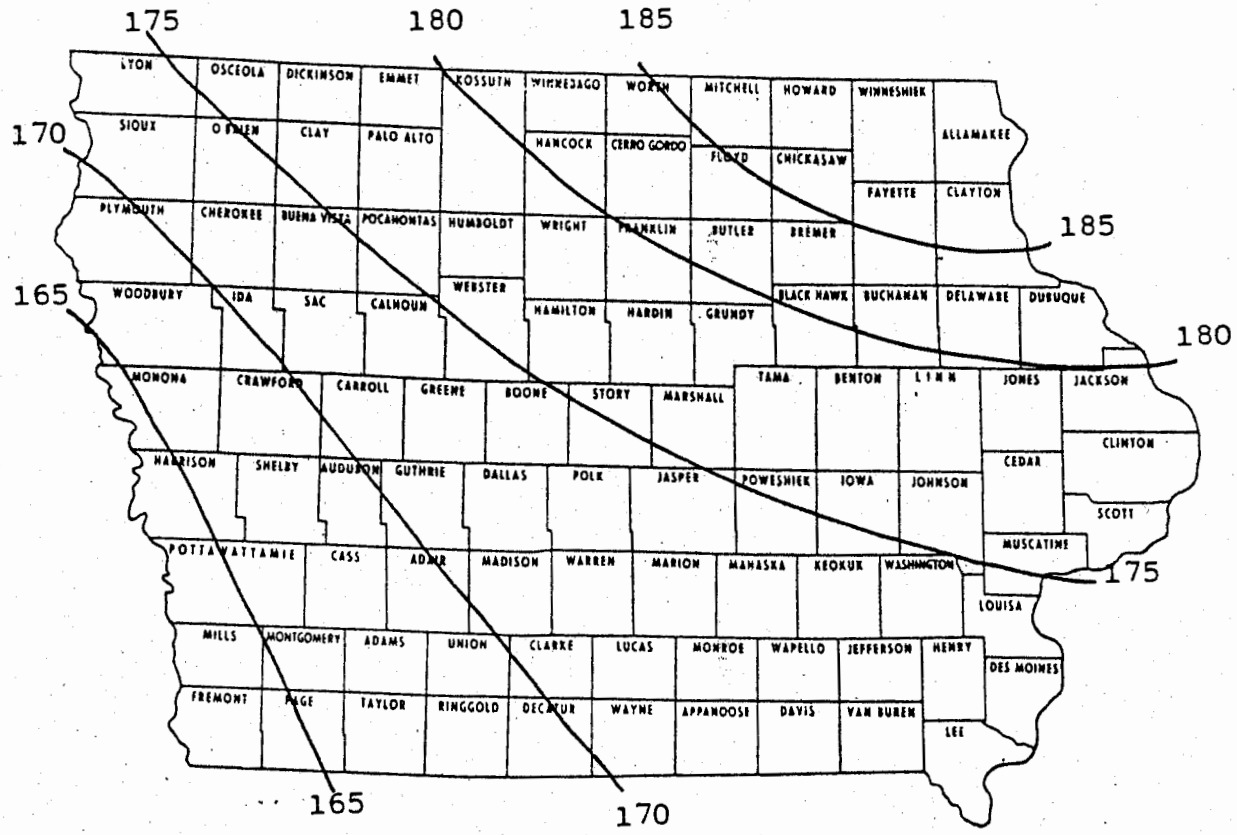

IOWA AVERAGE ANNUAL PRECIPITATION
1873-1984
PRECIPITATION (in)
45
40
35
30
25
20
15
1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980
YEAR


IOWA AVERAGE ANNUAL PRECIPITATION
10-YEAR RUNNING MEAN
PRECIPITATION (in)
35
34
33
32
31
30
29
28
27
26
1880 1890 1900 1910 1920 1930 1940 1950 1960 1970
5th YEAR OF MEAN

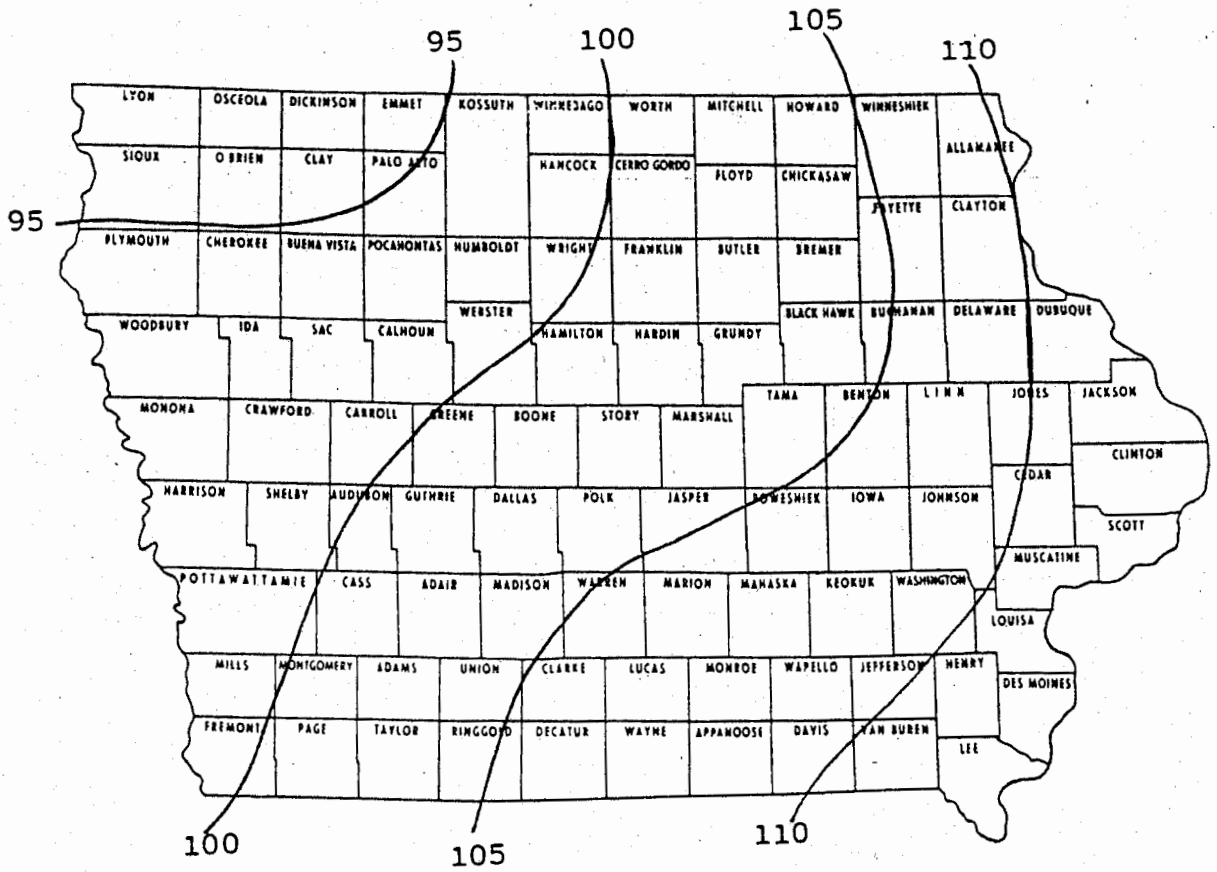


NORMAL PRECIPITATION FOR IOWA (1941-1970)

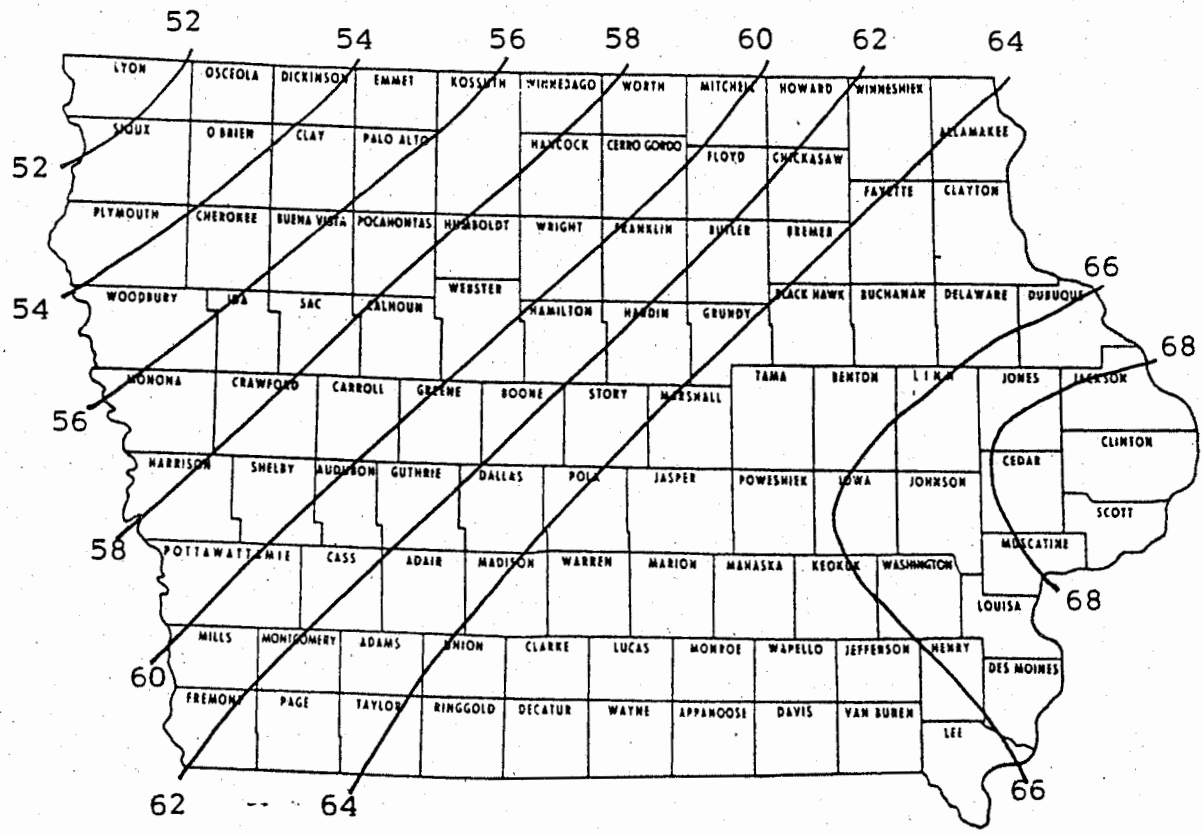
Average number days per year with a trace or more precipitation



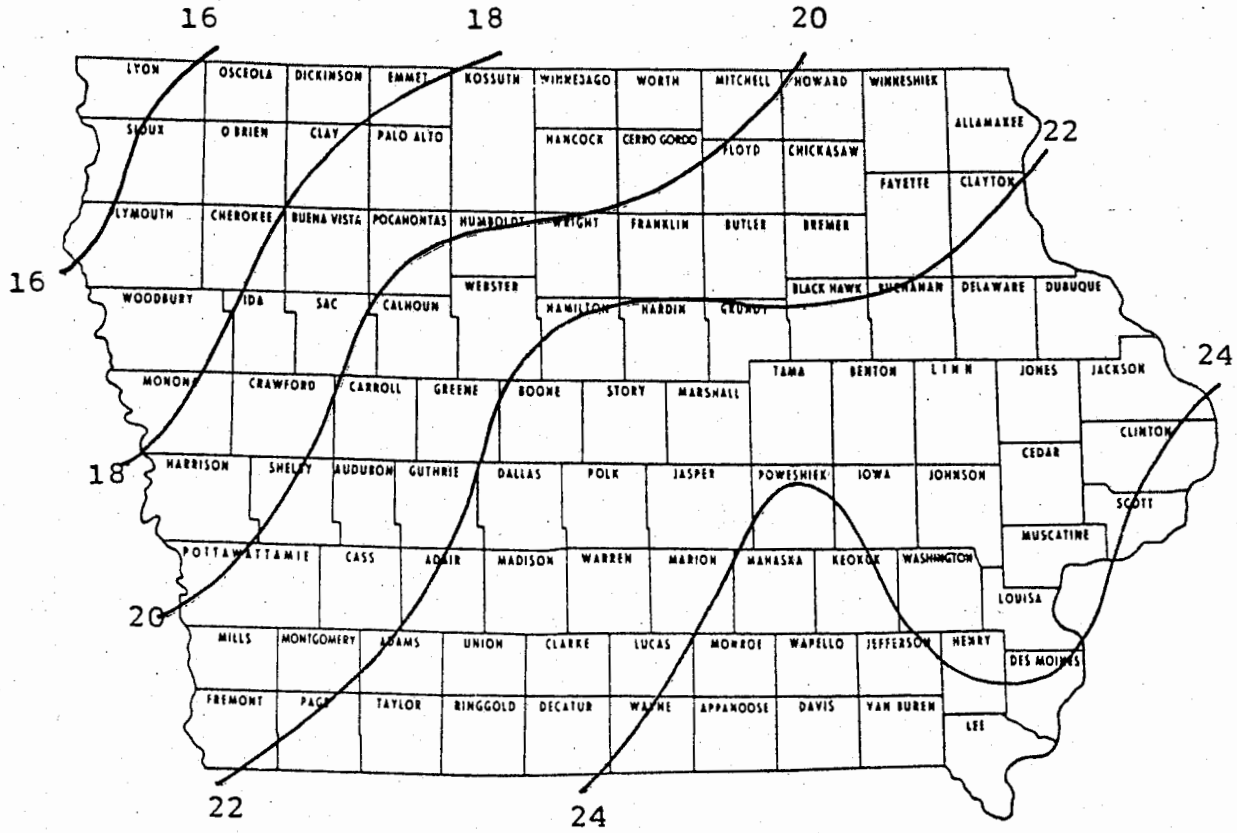
Average number days per year with 0.01 inch or more precipitation



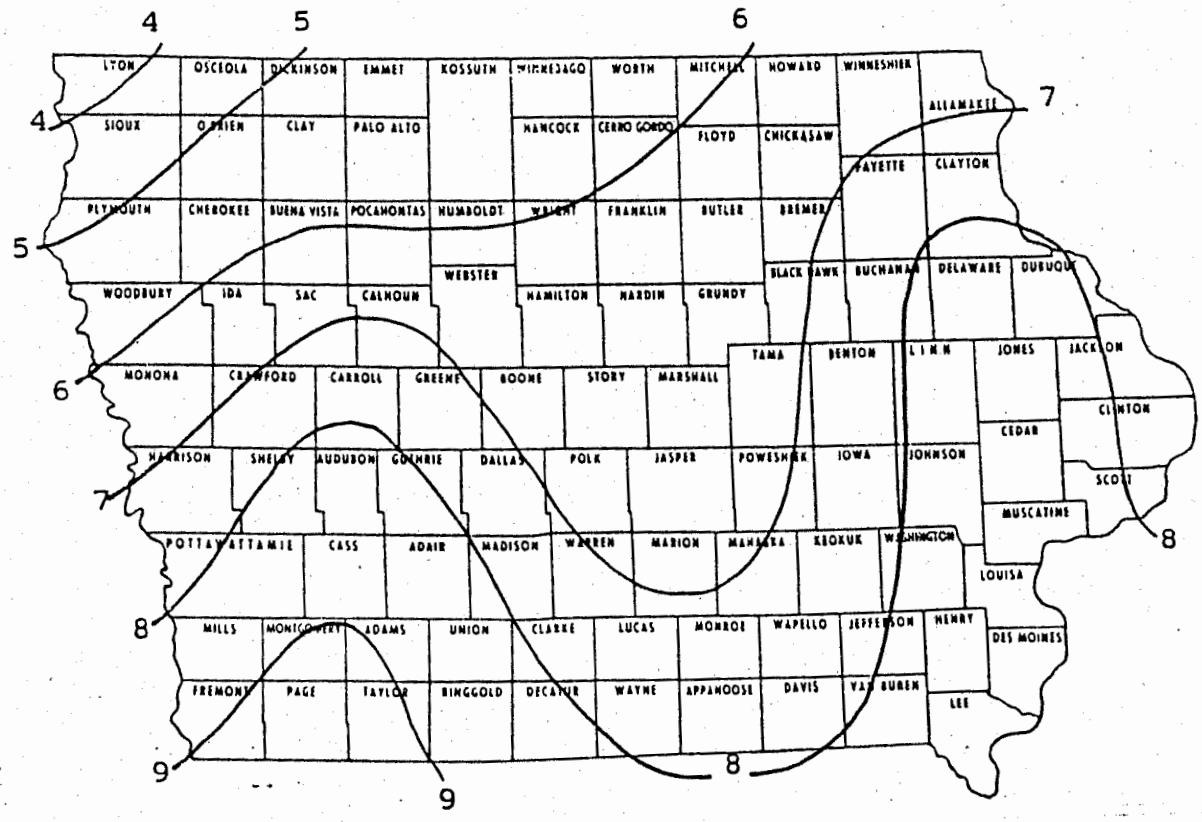
Average number days per year with 0.10 inch or more precipitation



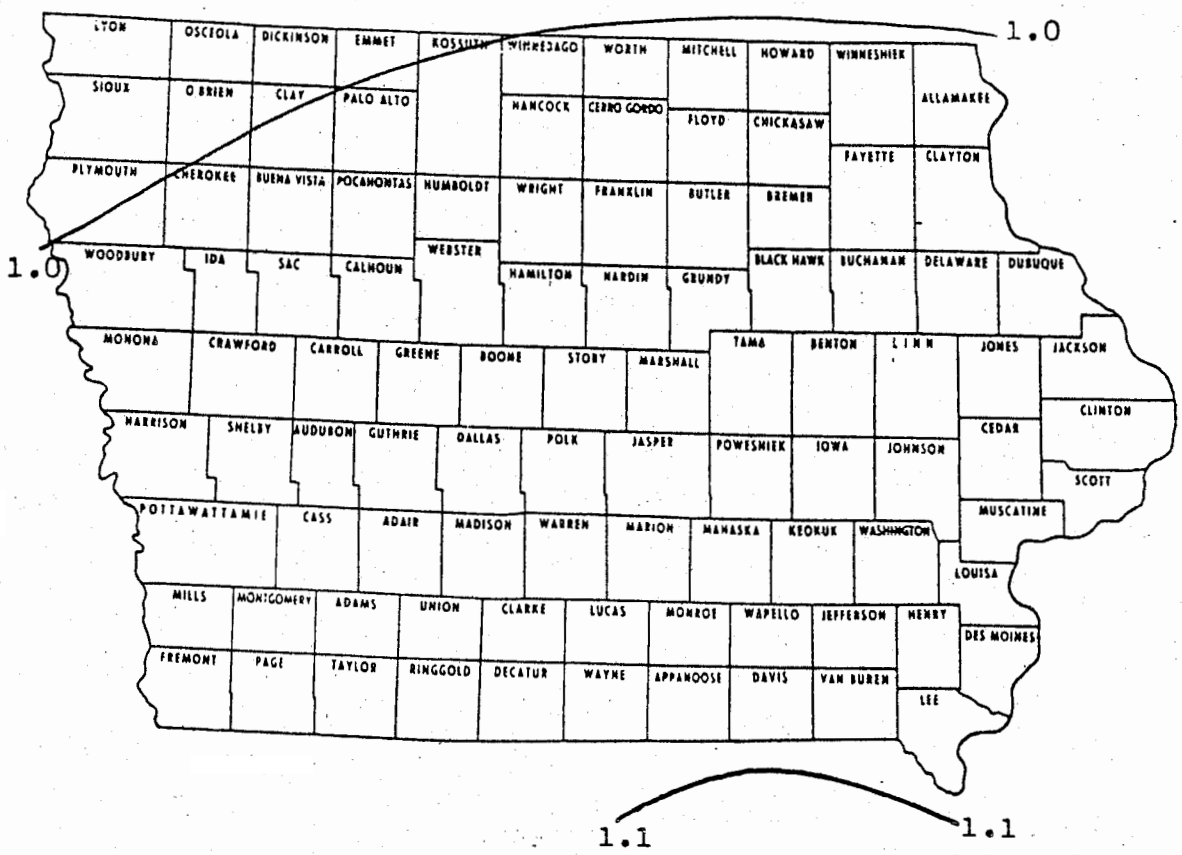
Average number days per year with 0.50 inch or more precipitation



Average number days per year with one inch or more precipitation



1 - Year 30 - Minute Rainfall (Inches)



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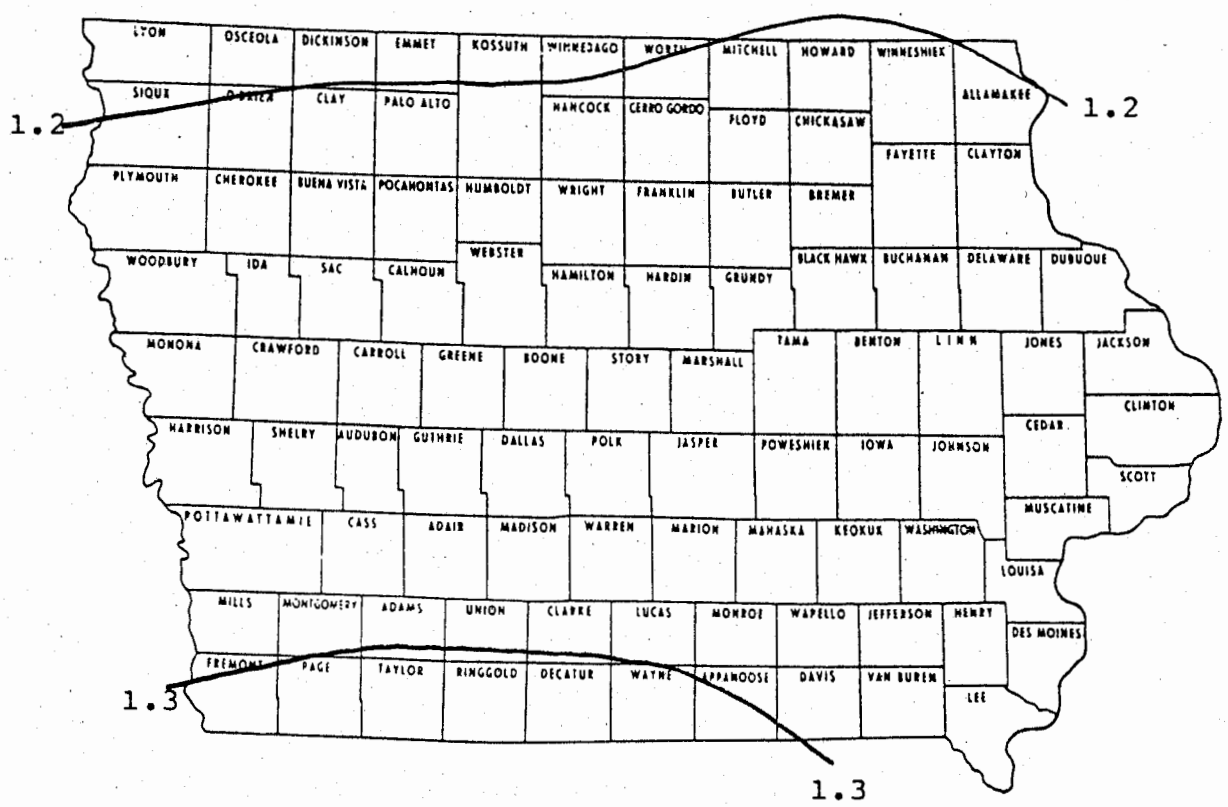

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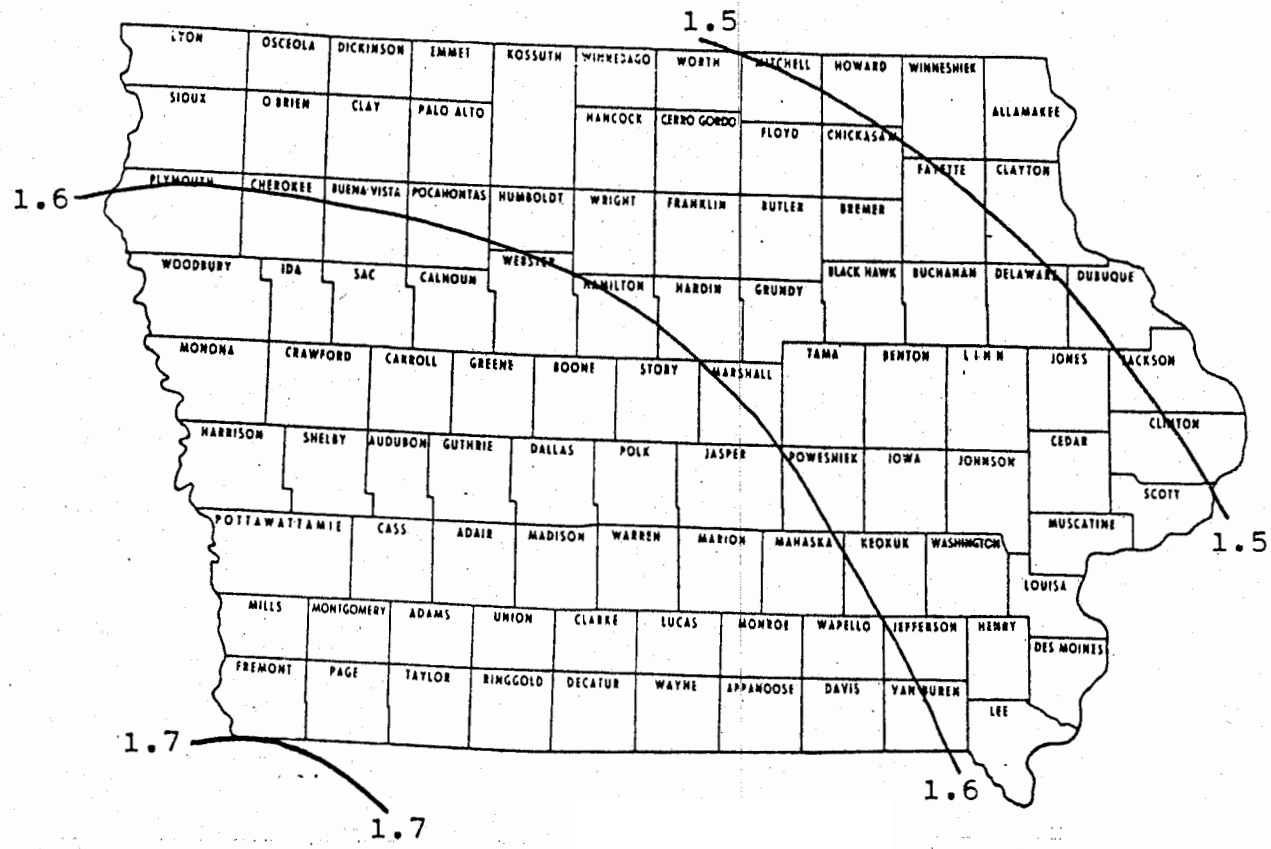
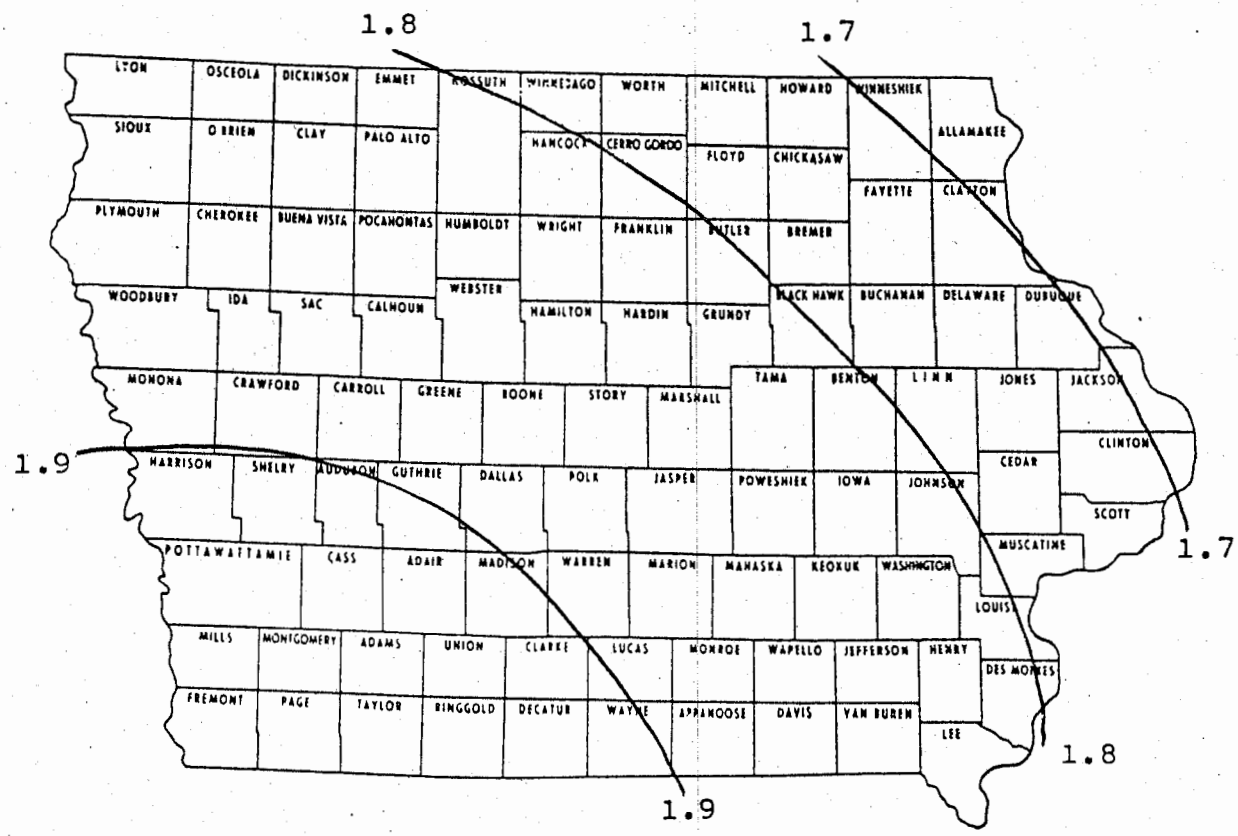
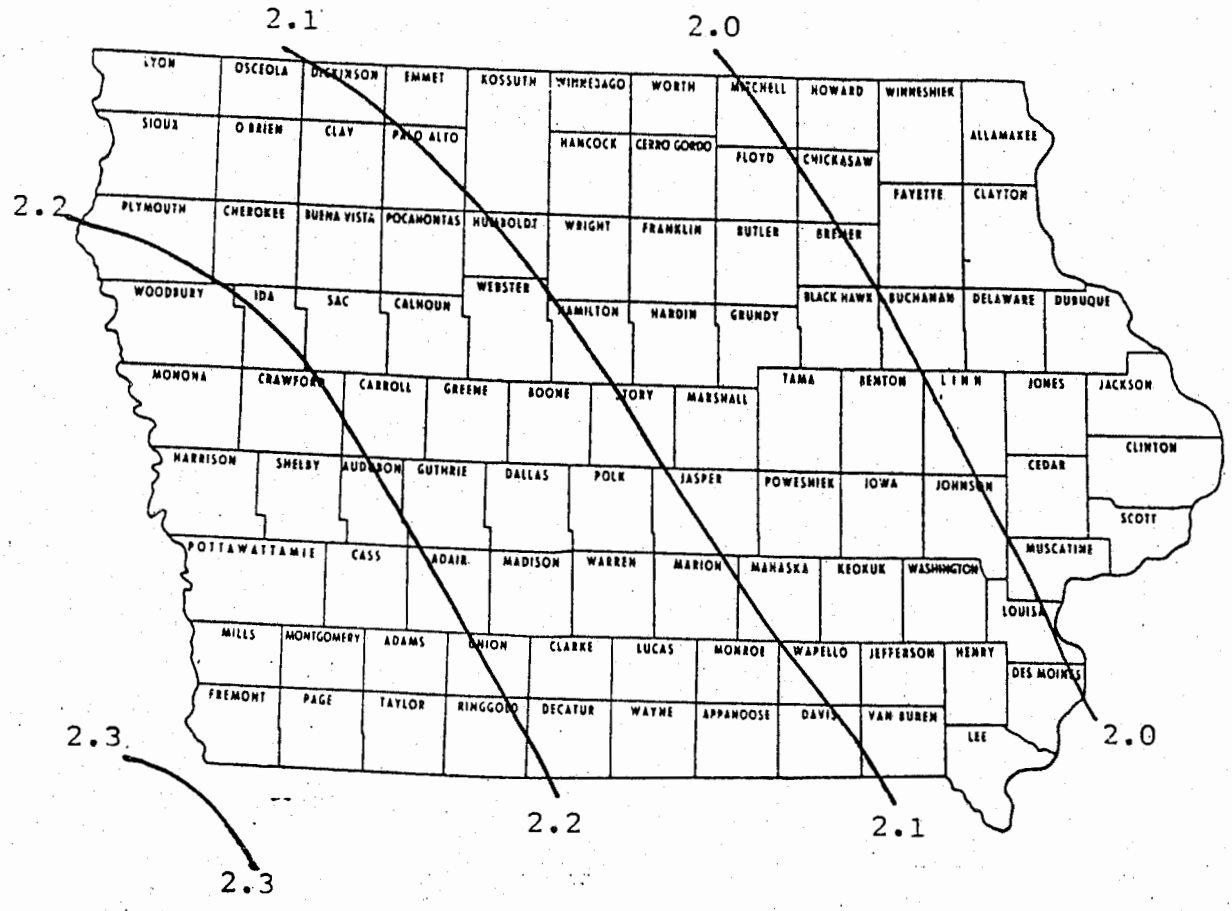


10 - Year 30 - Minute Rainfall (Inches)



25 - Year 30-Minute Rainfall (Inches)



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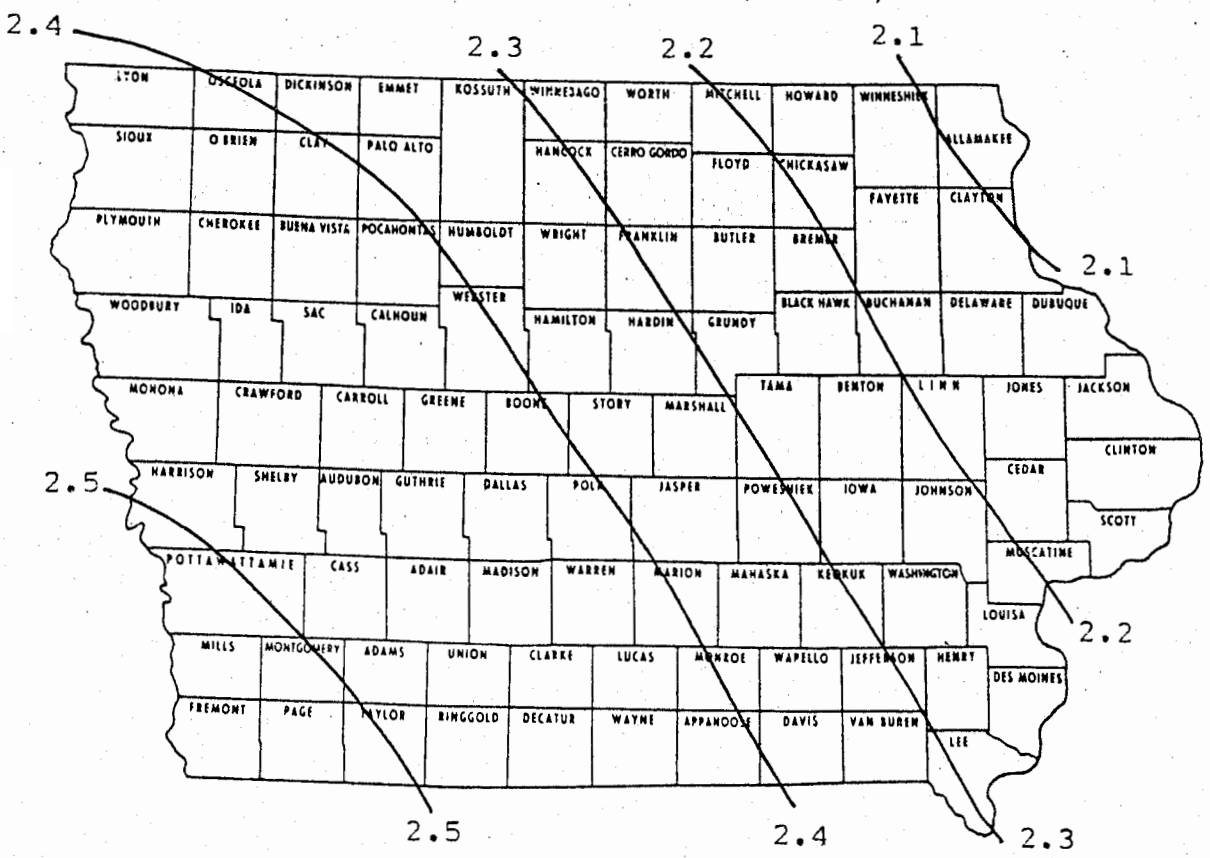

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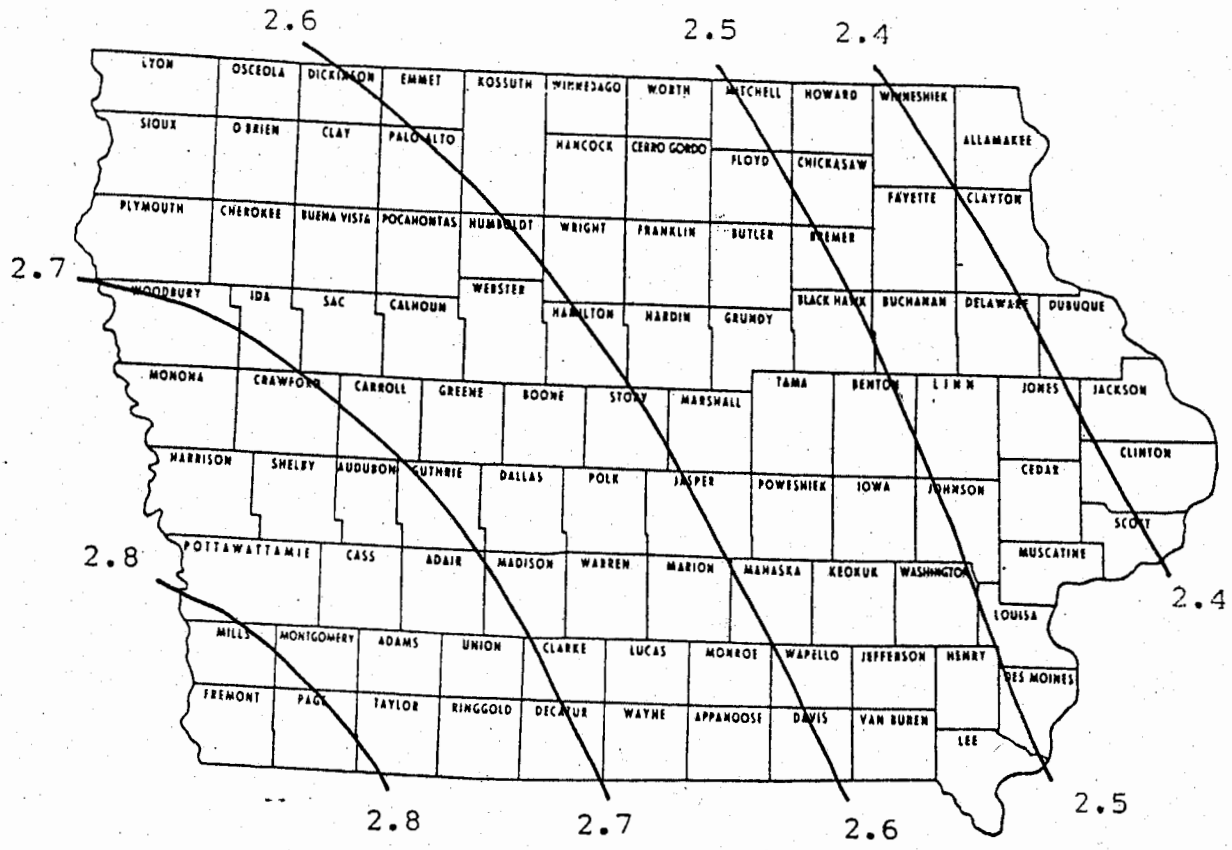
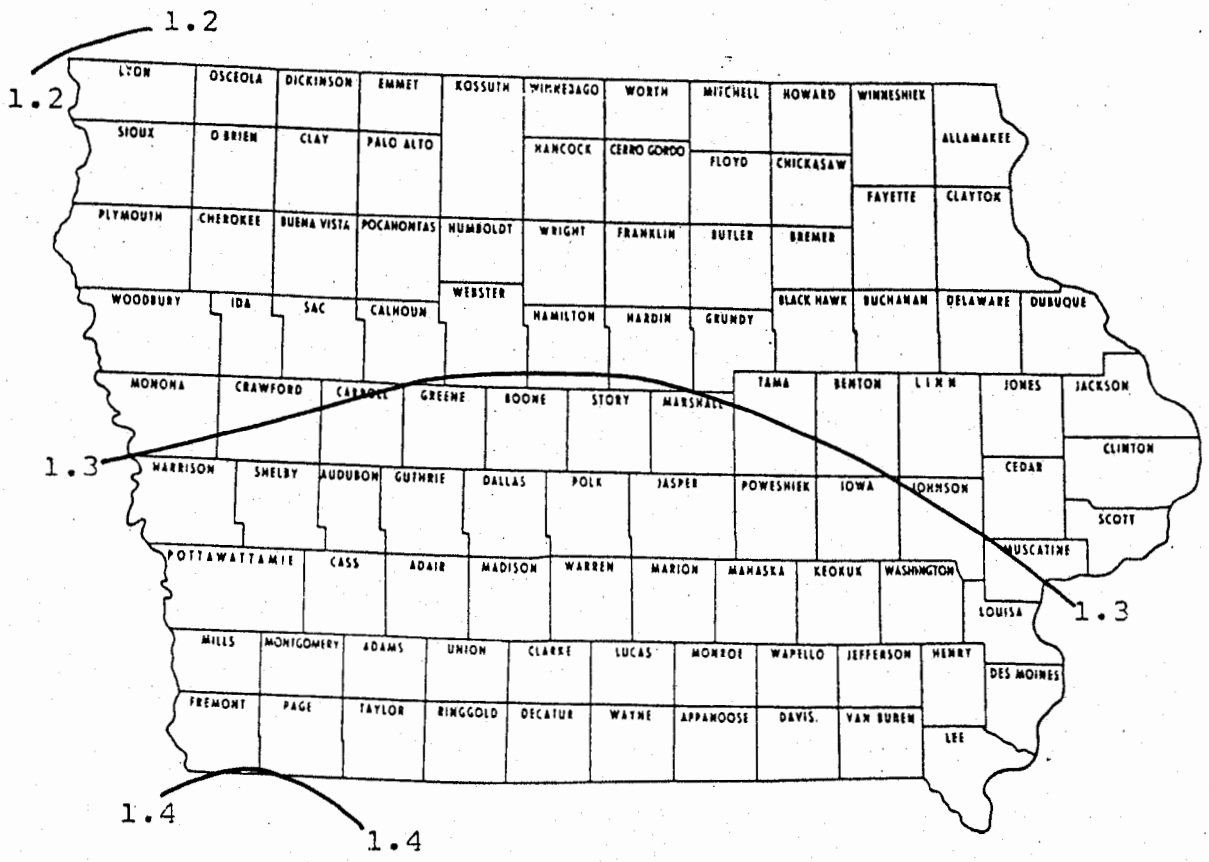


1 - Year 1-Hour Rainfall (Inches)



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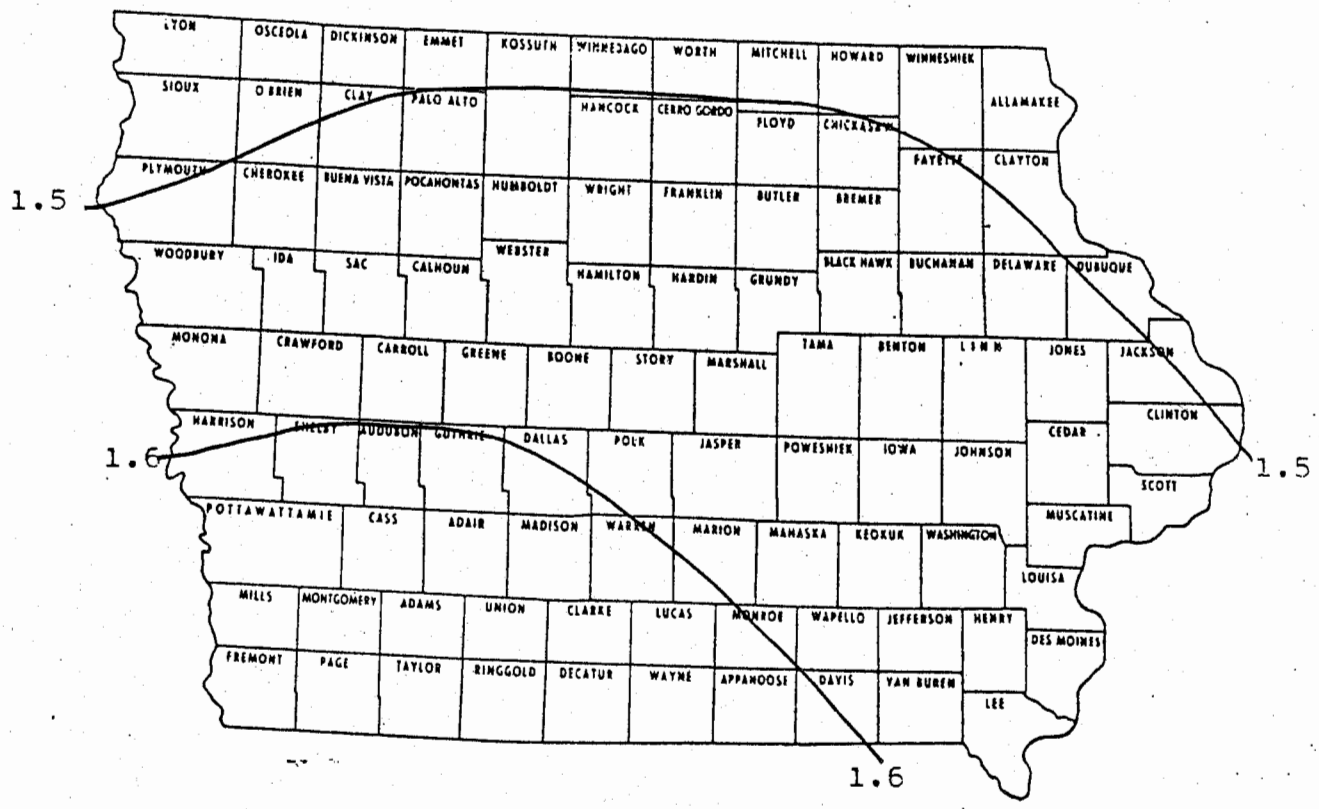

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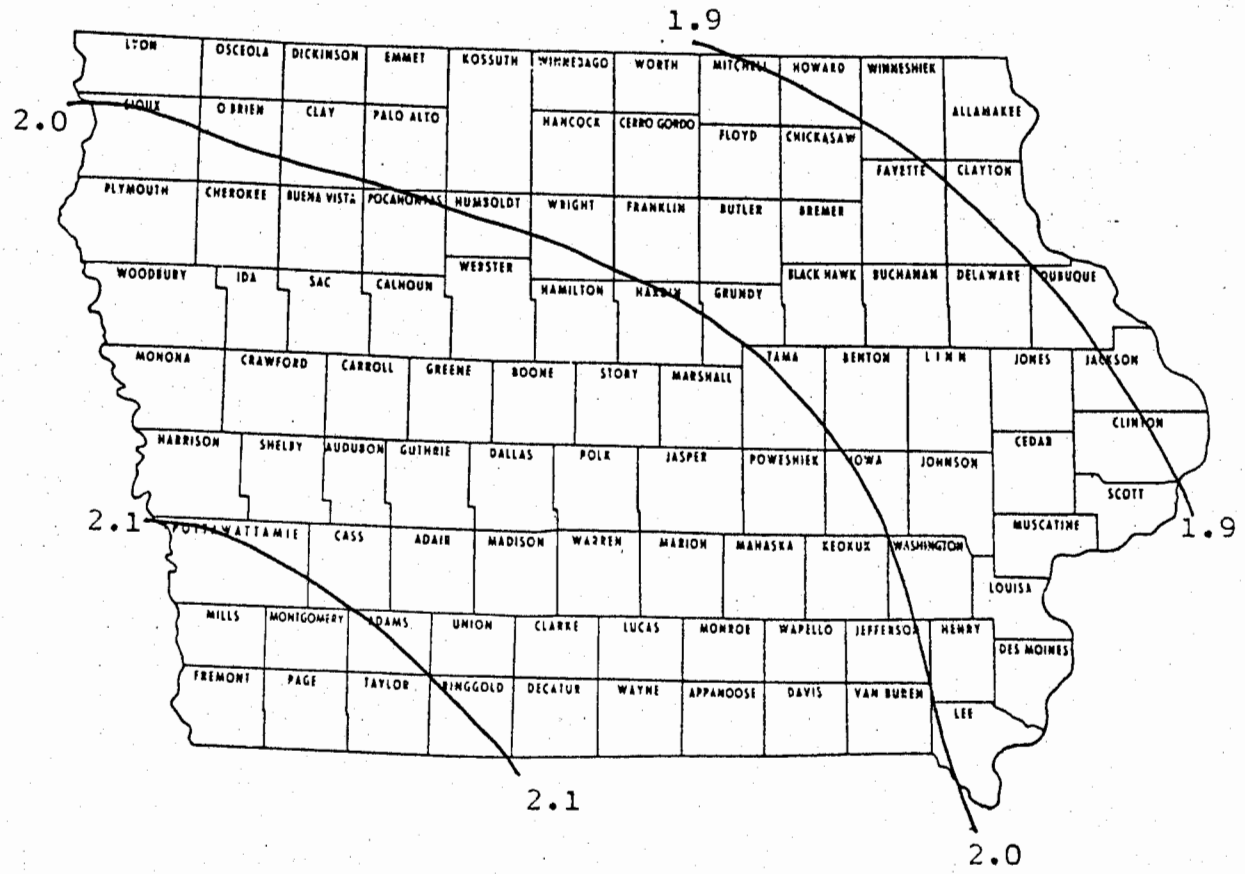

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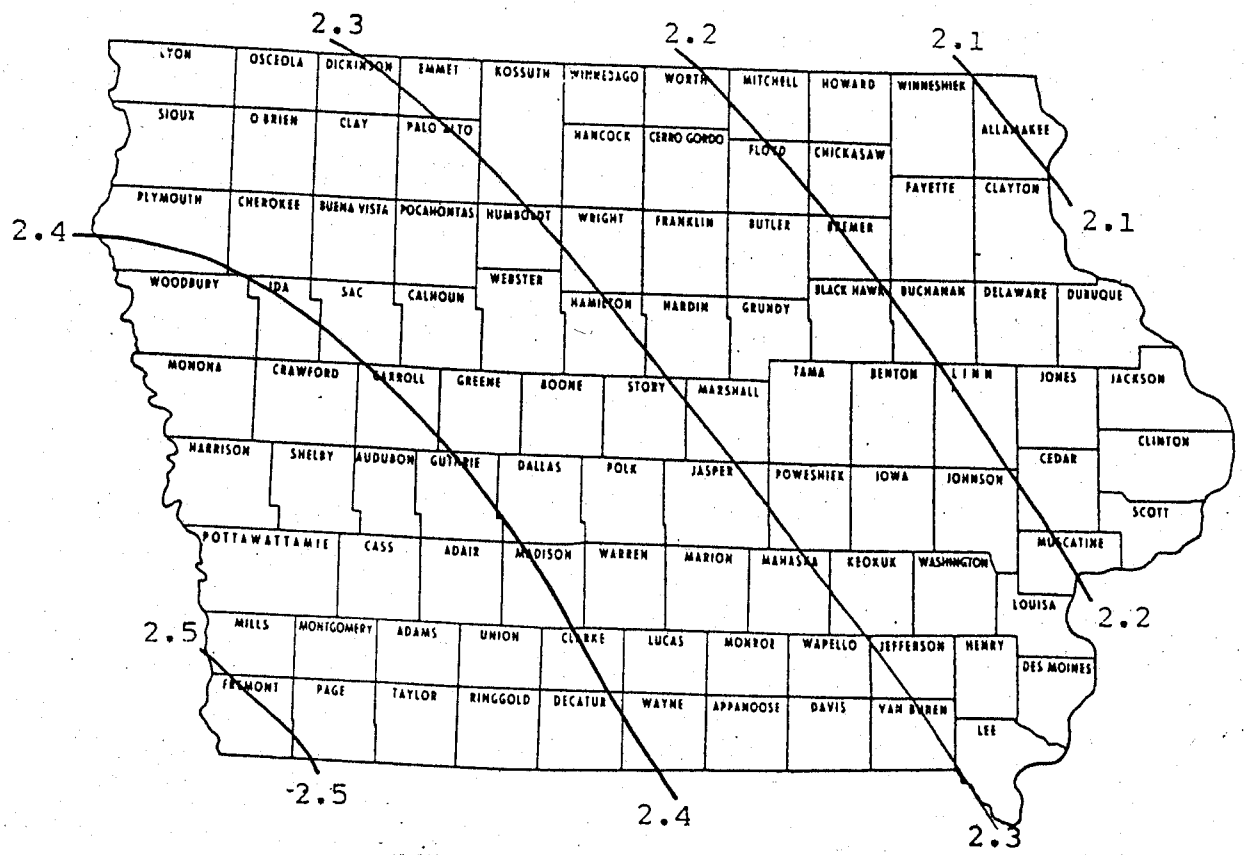

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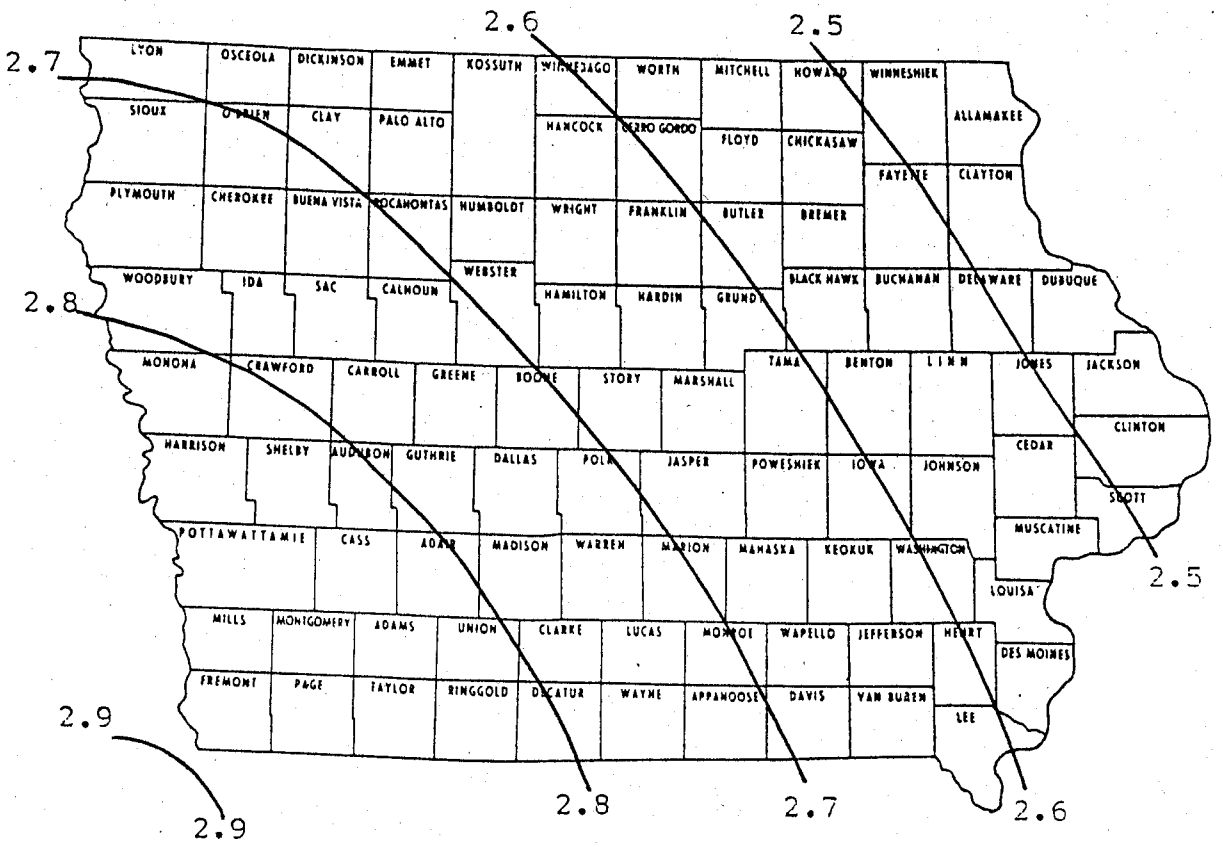

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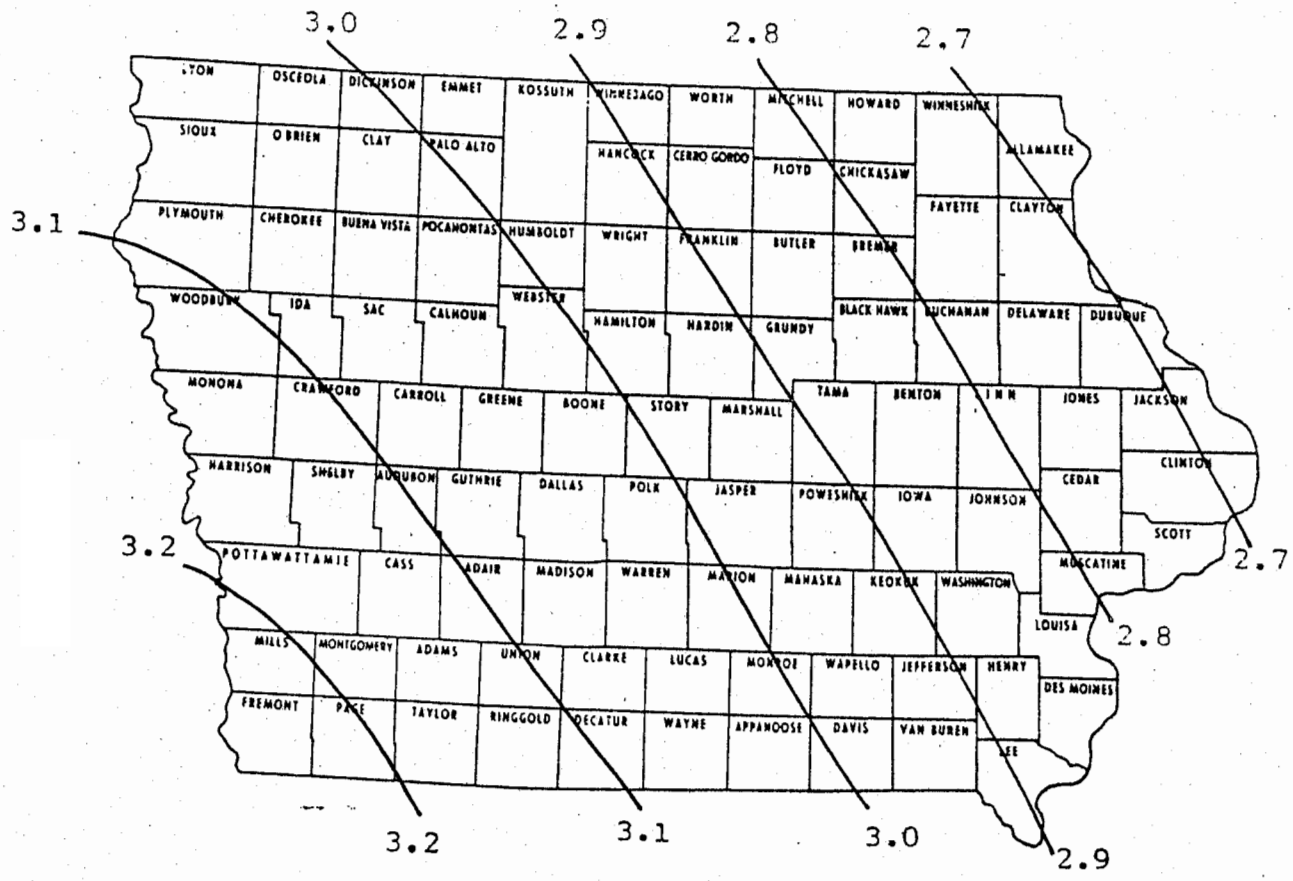

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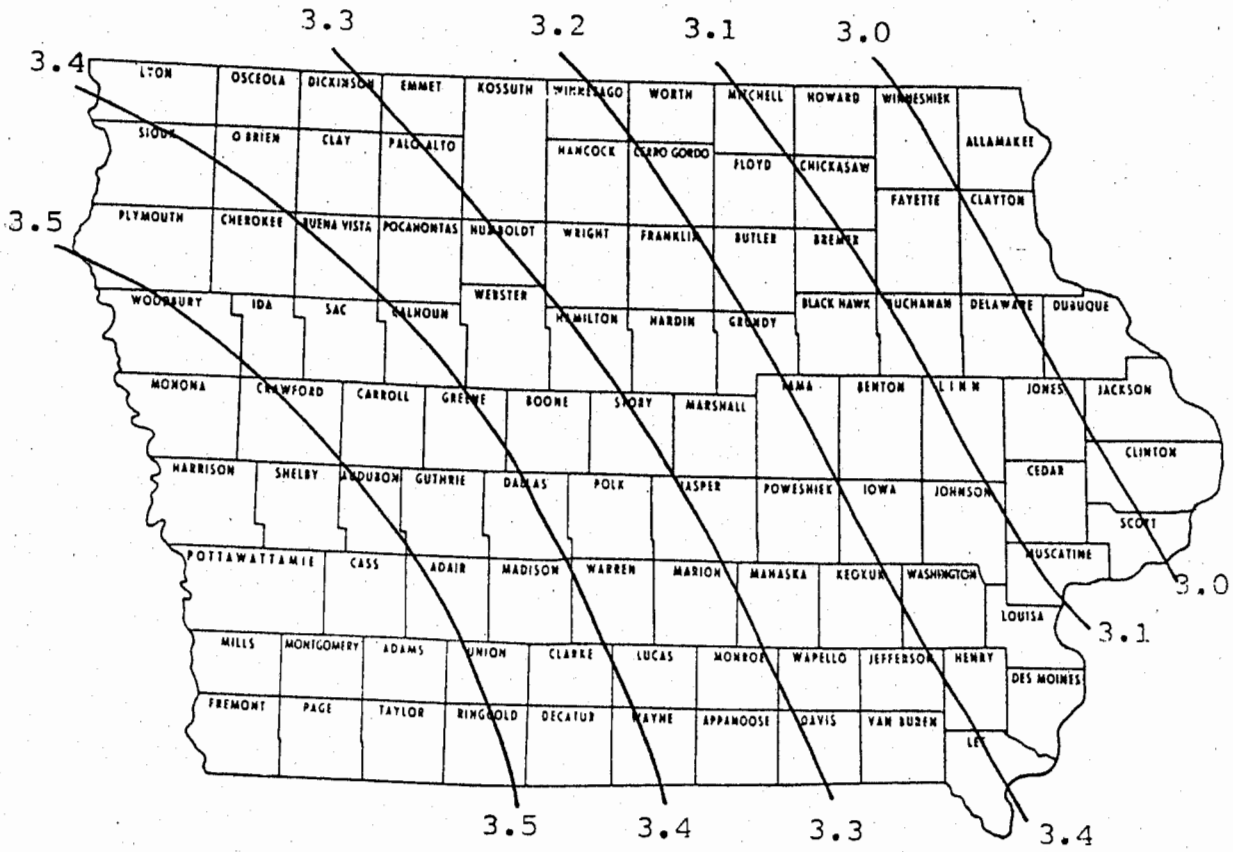

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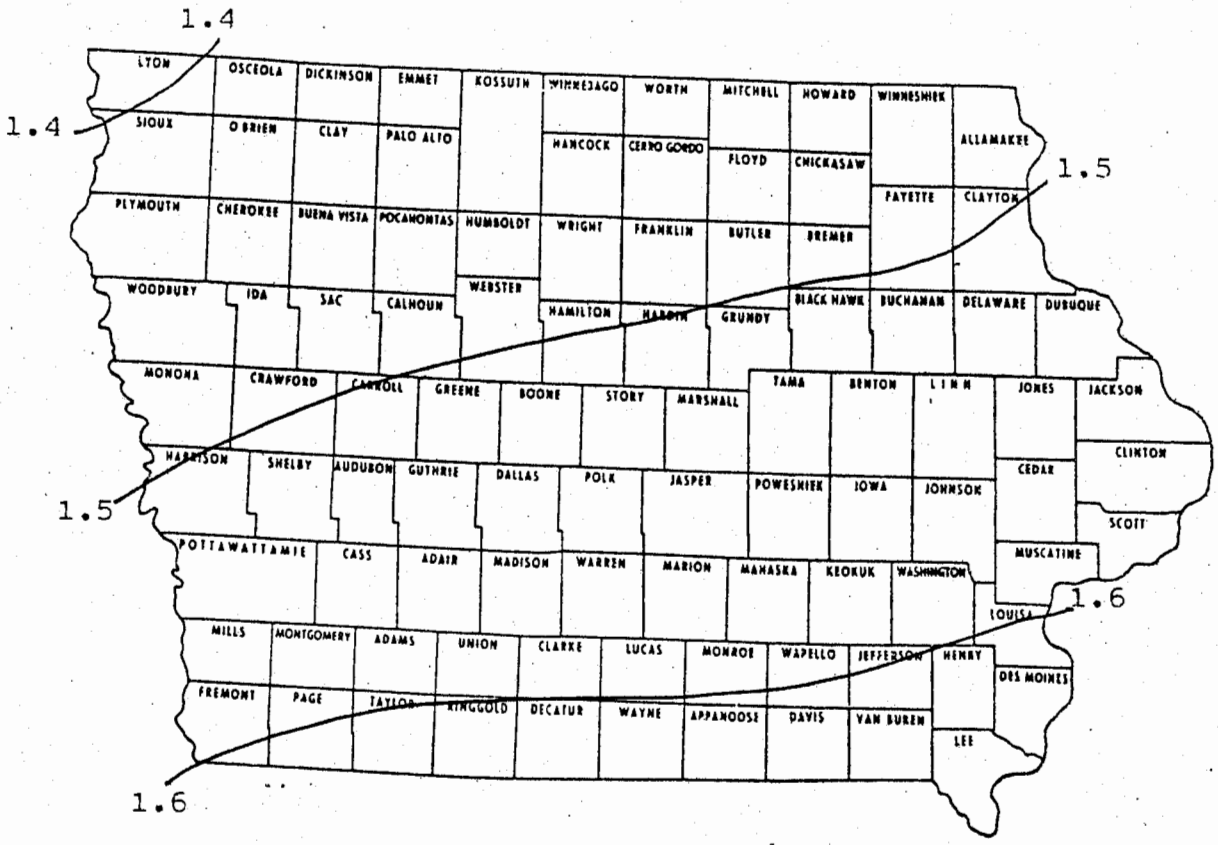

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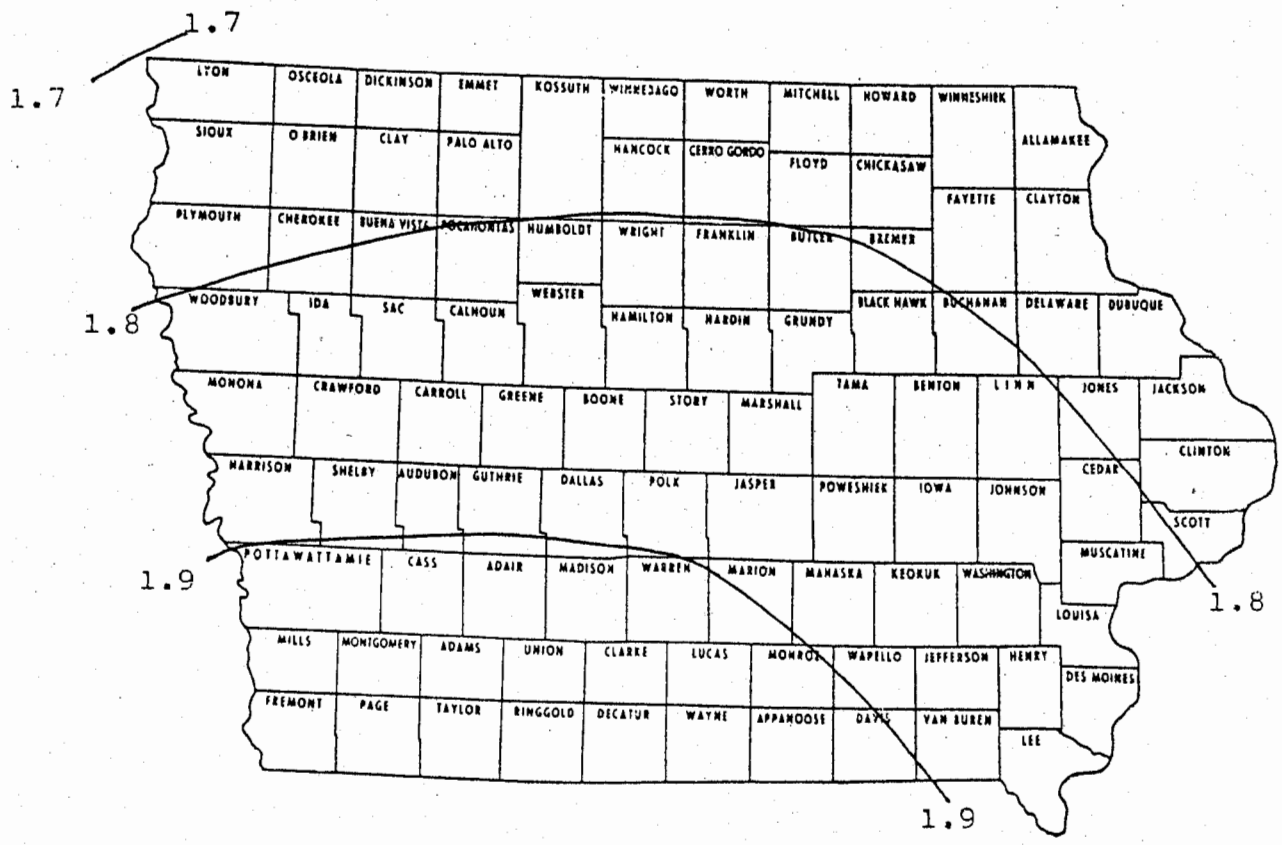

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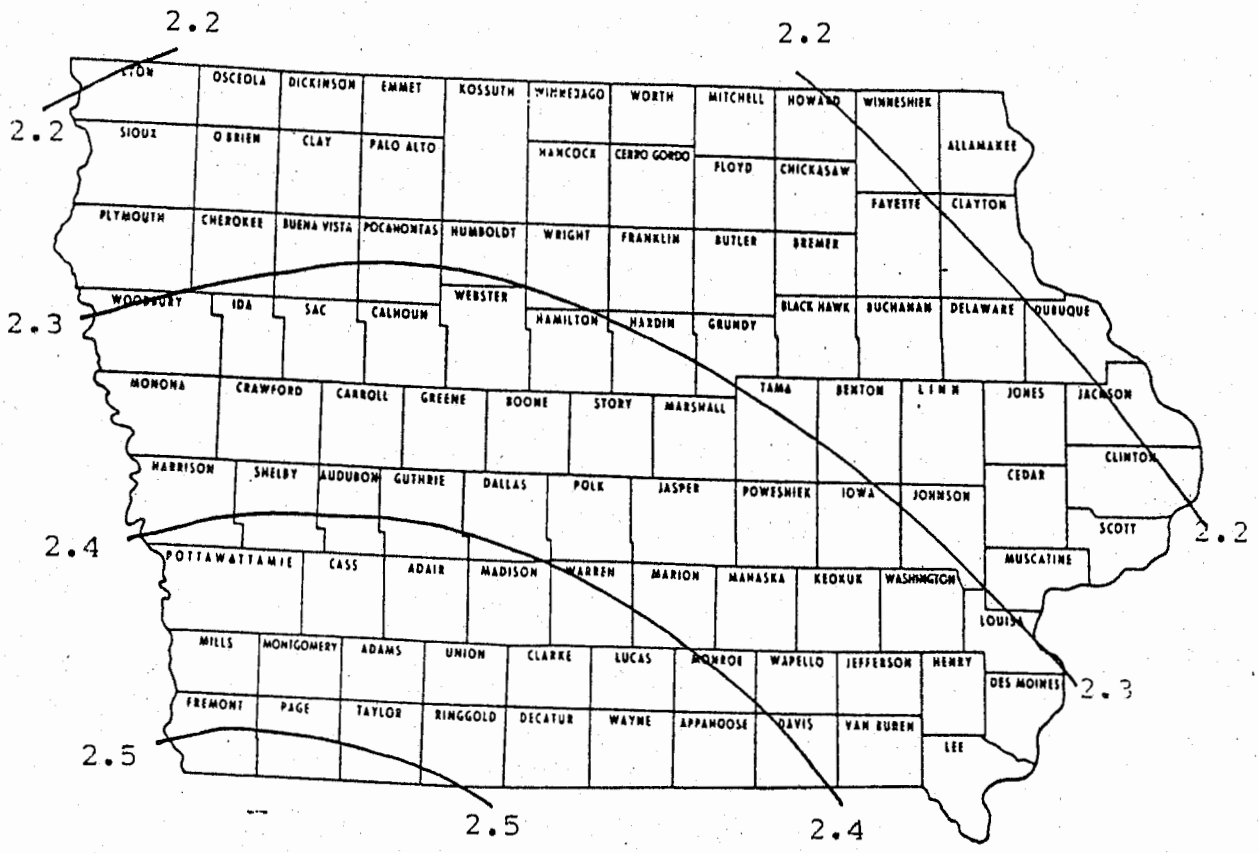

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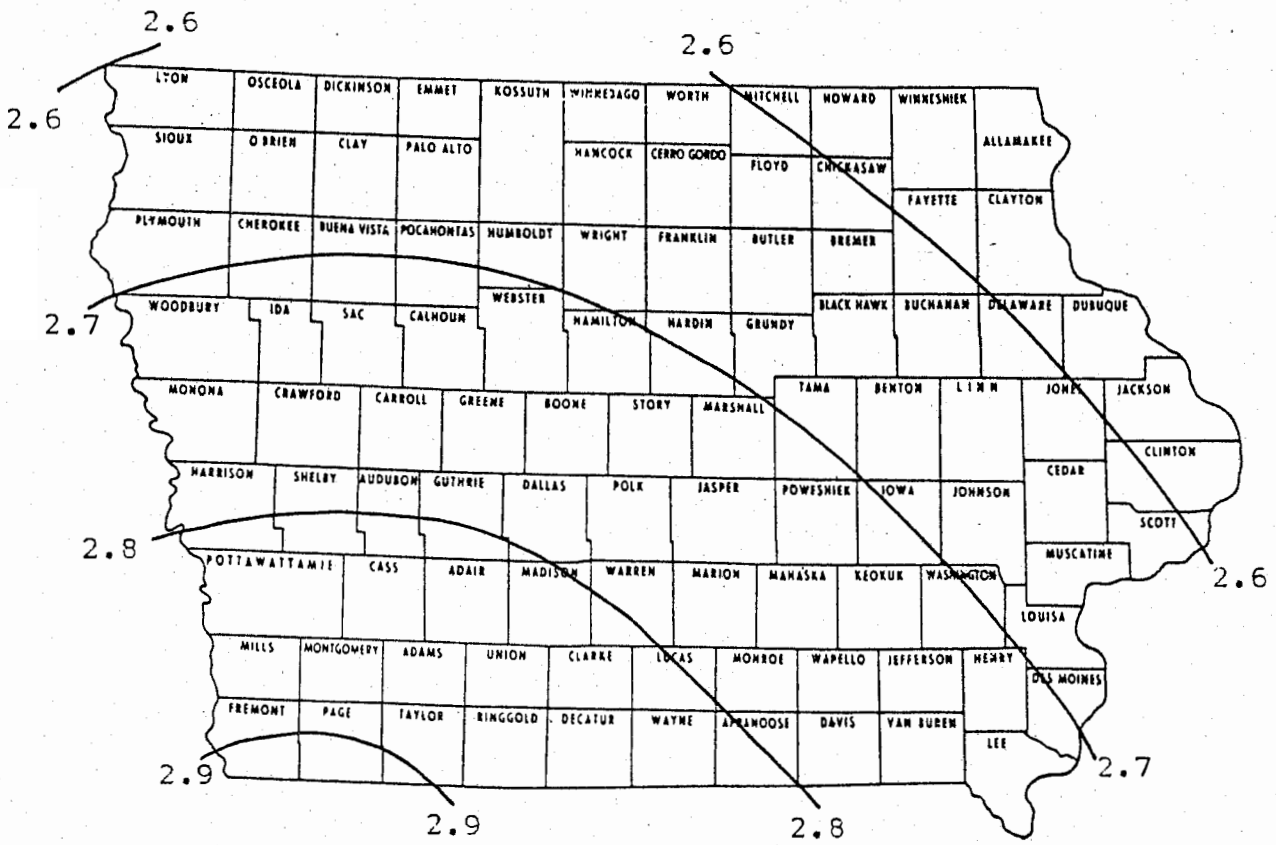

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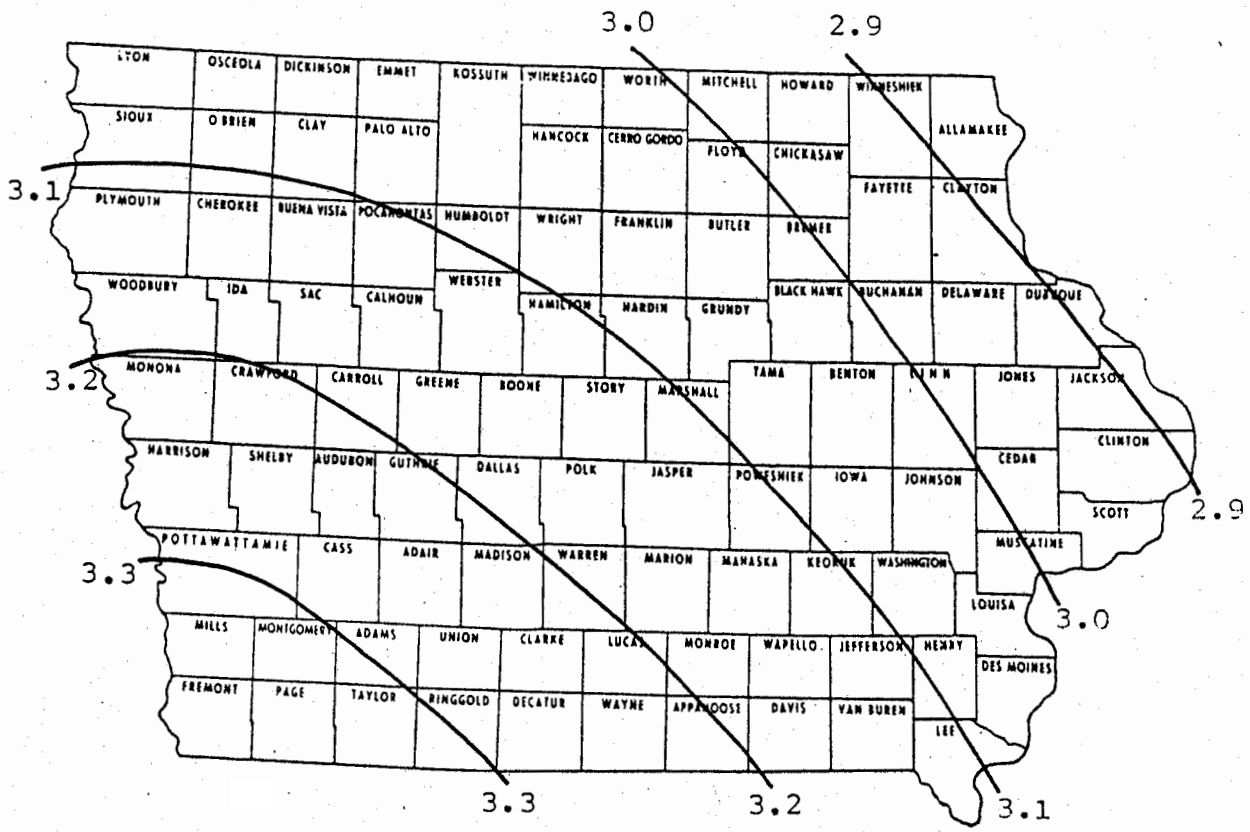

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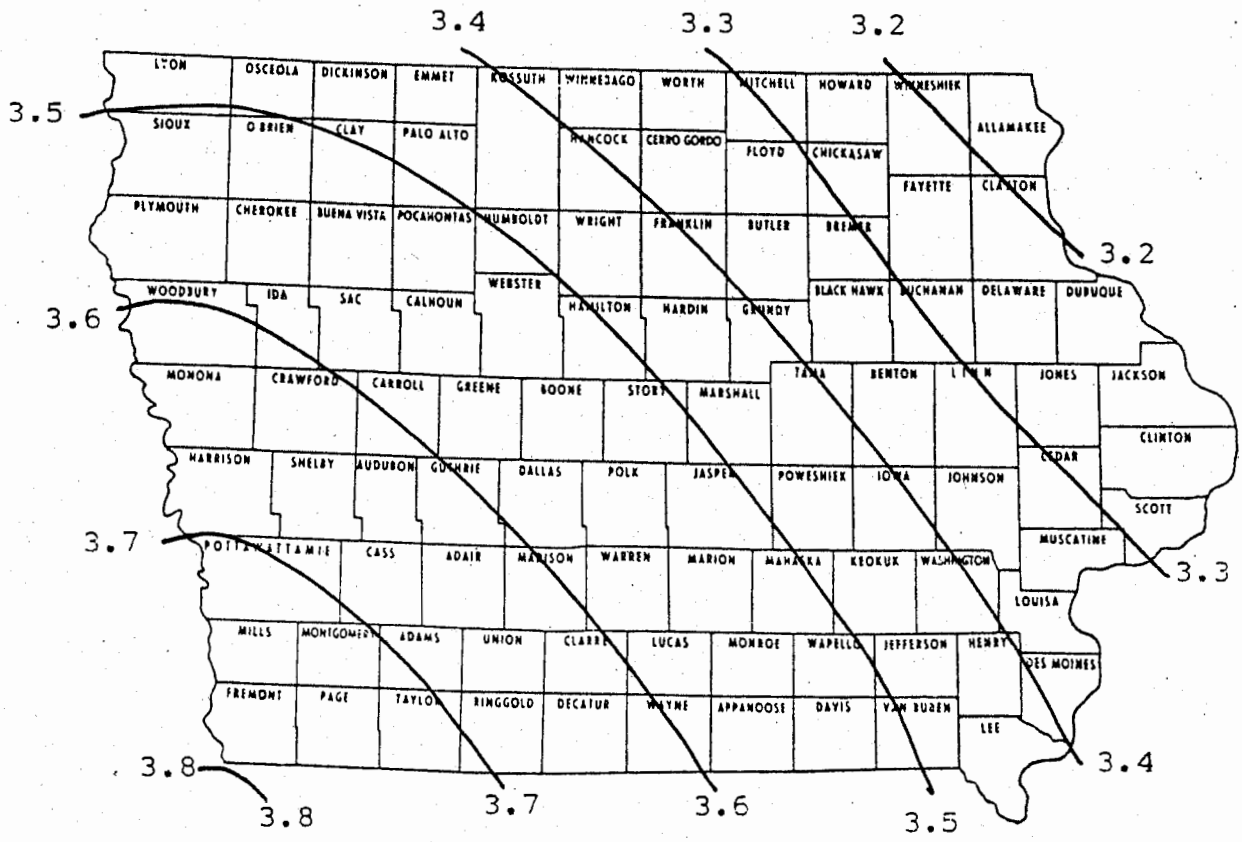

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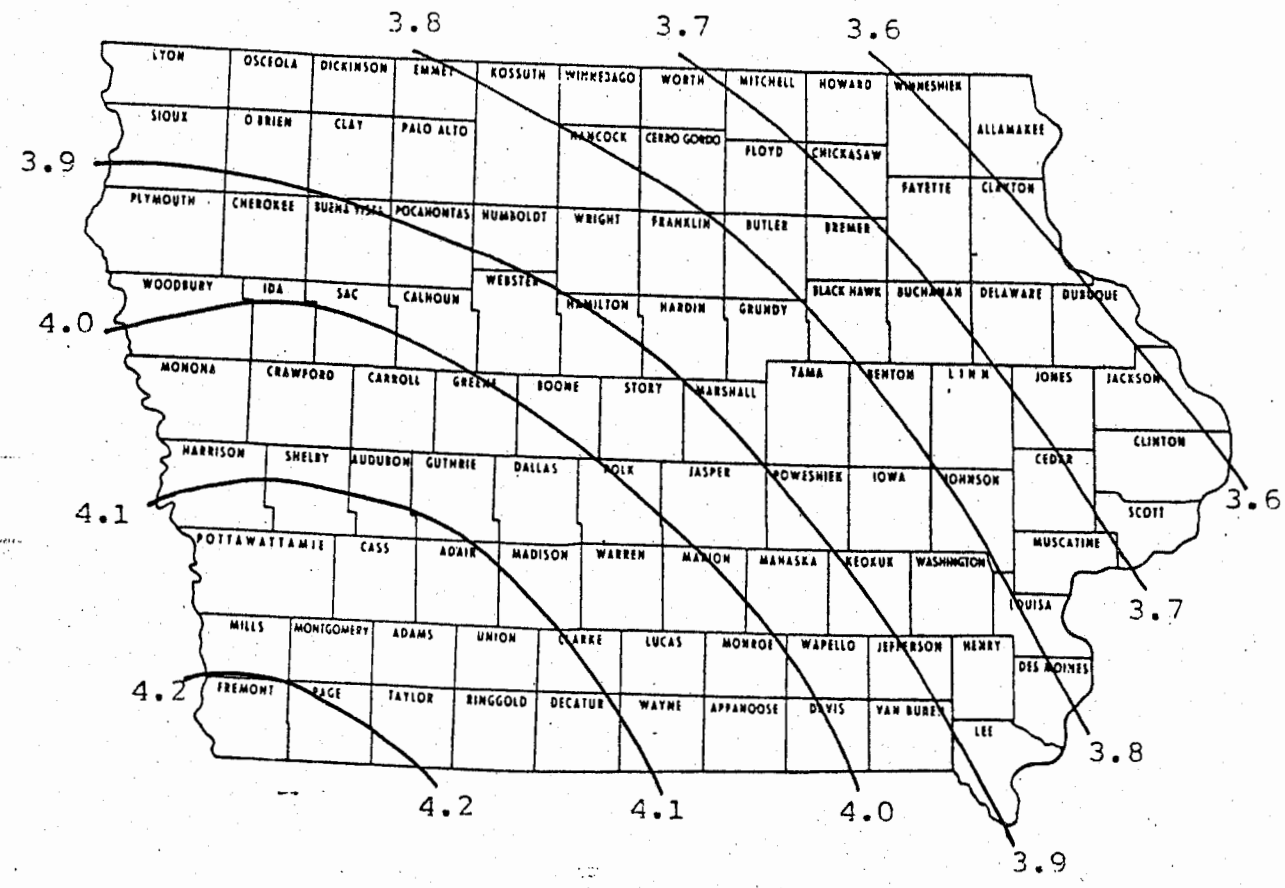

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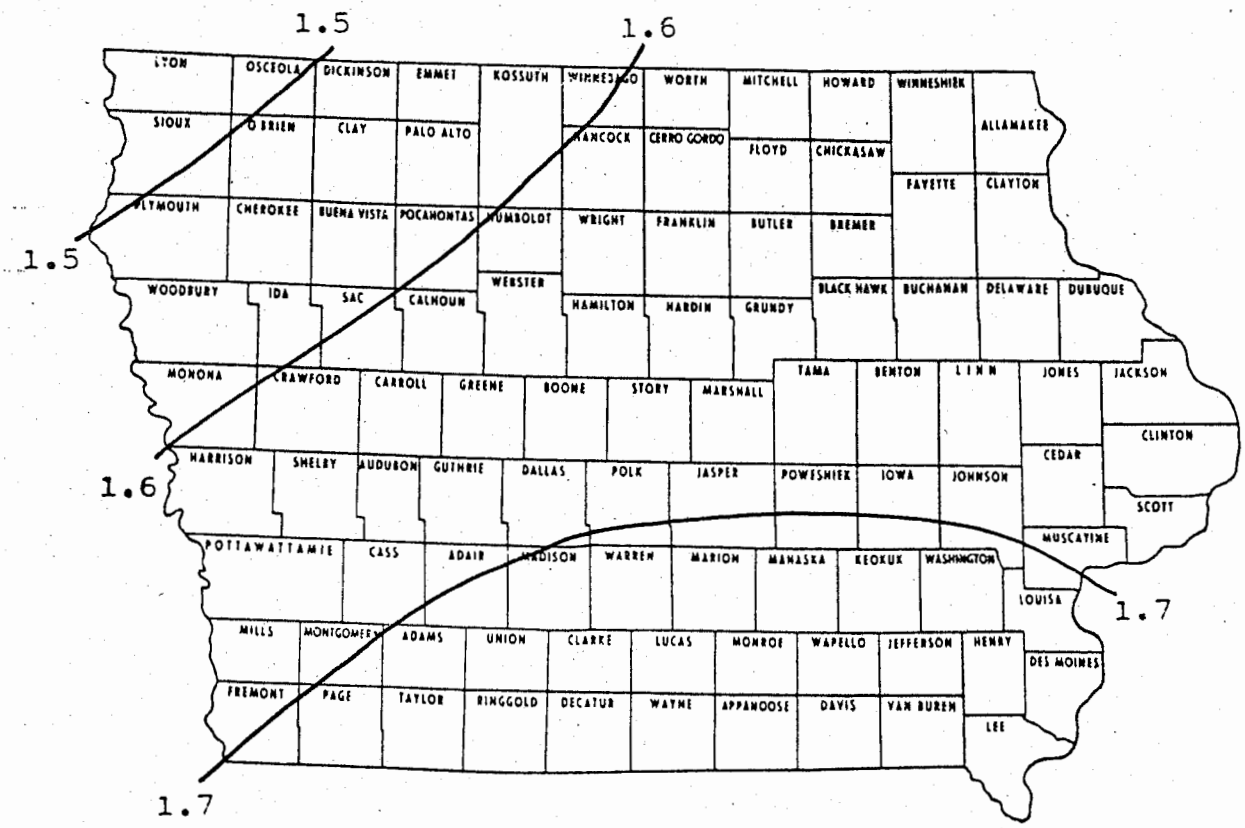

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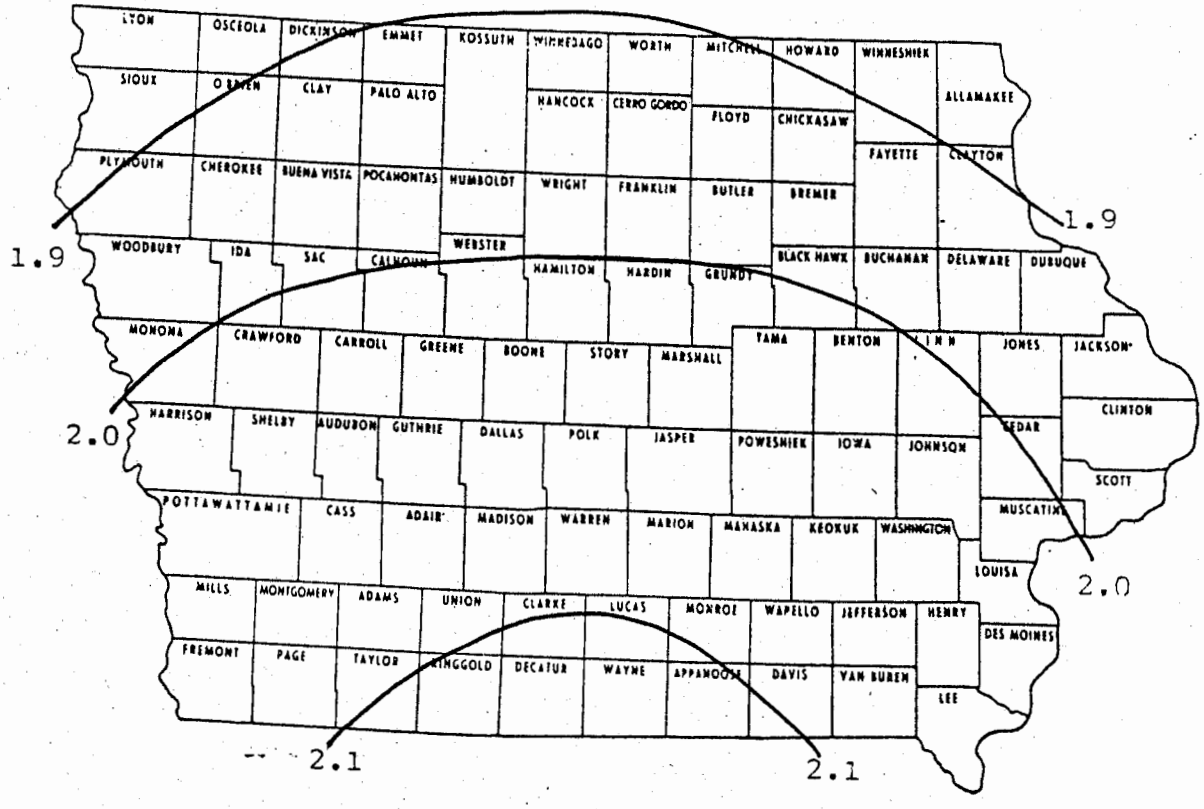

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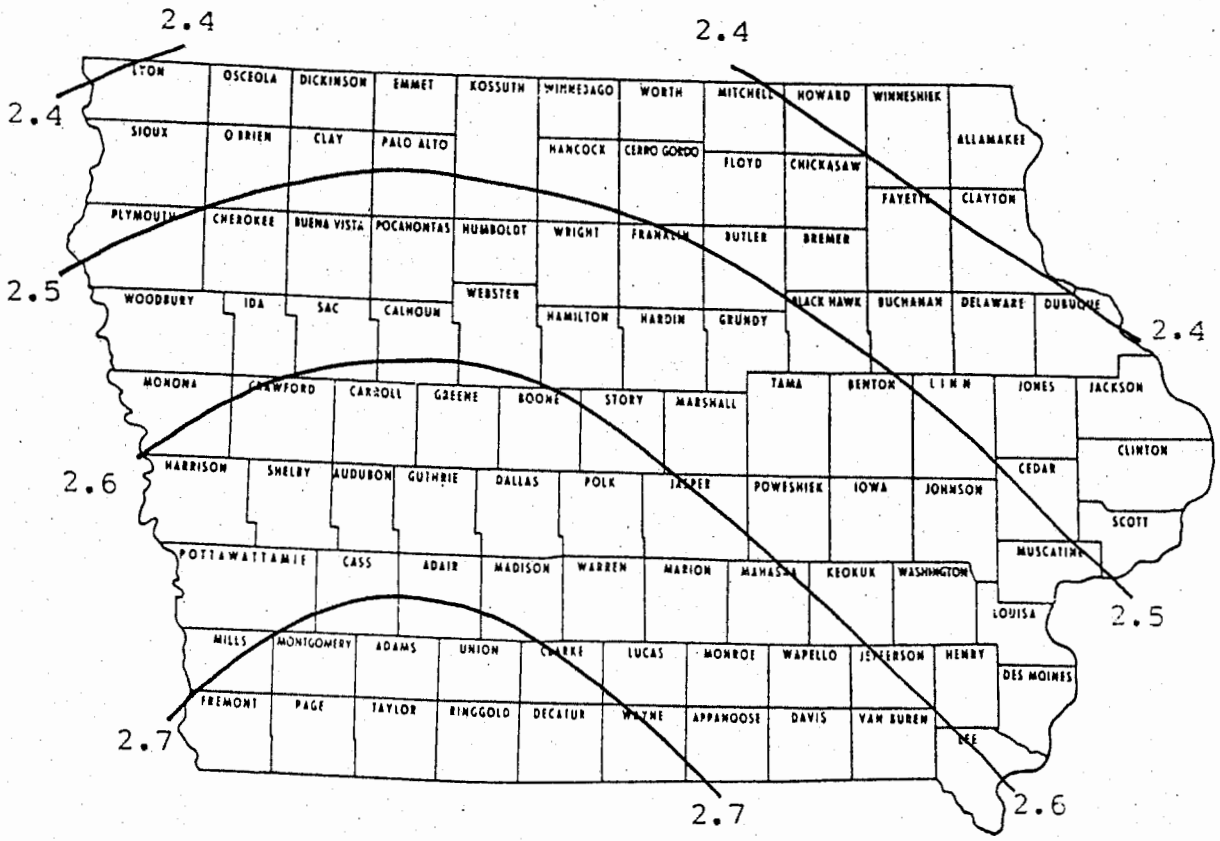

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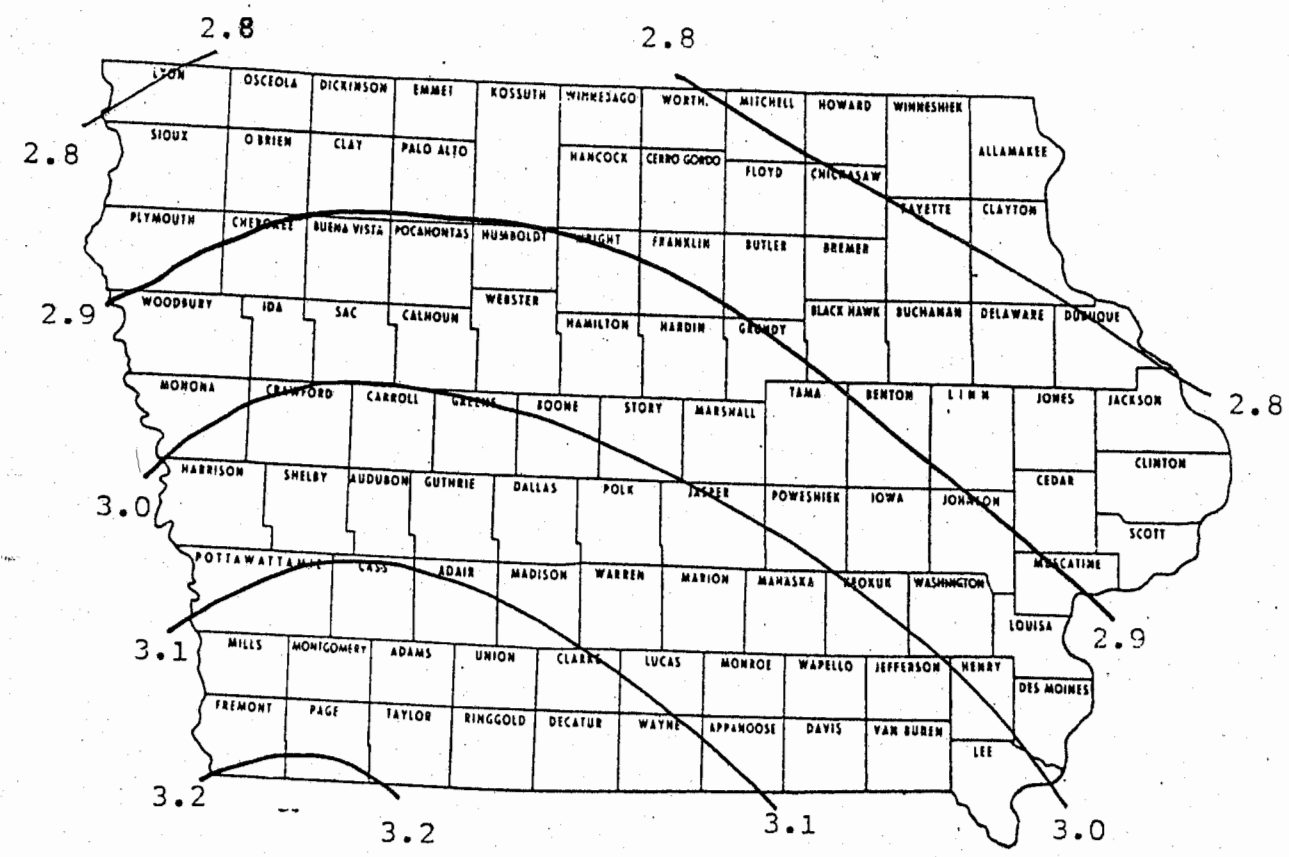

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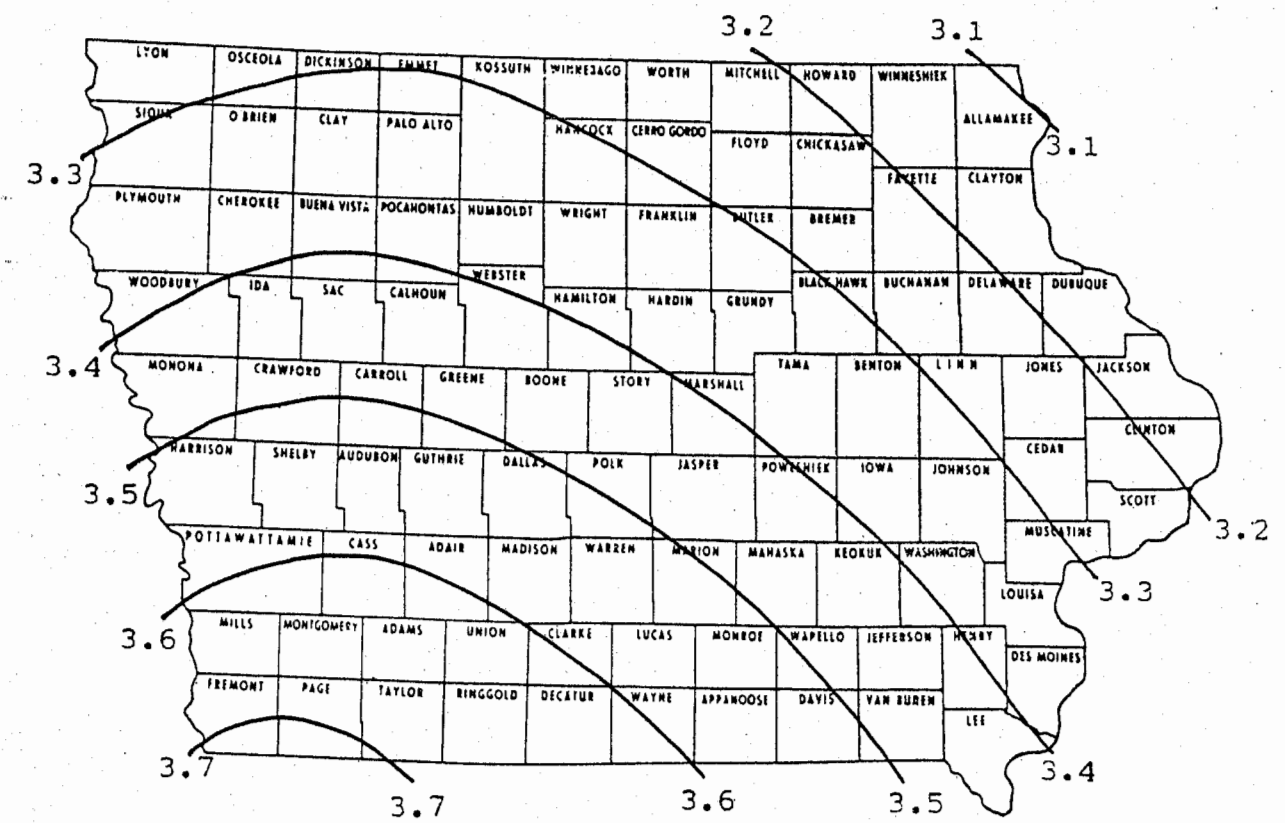

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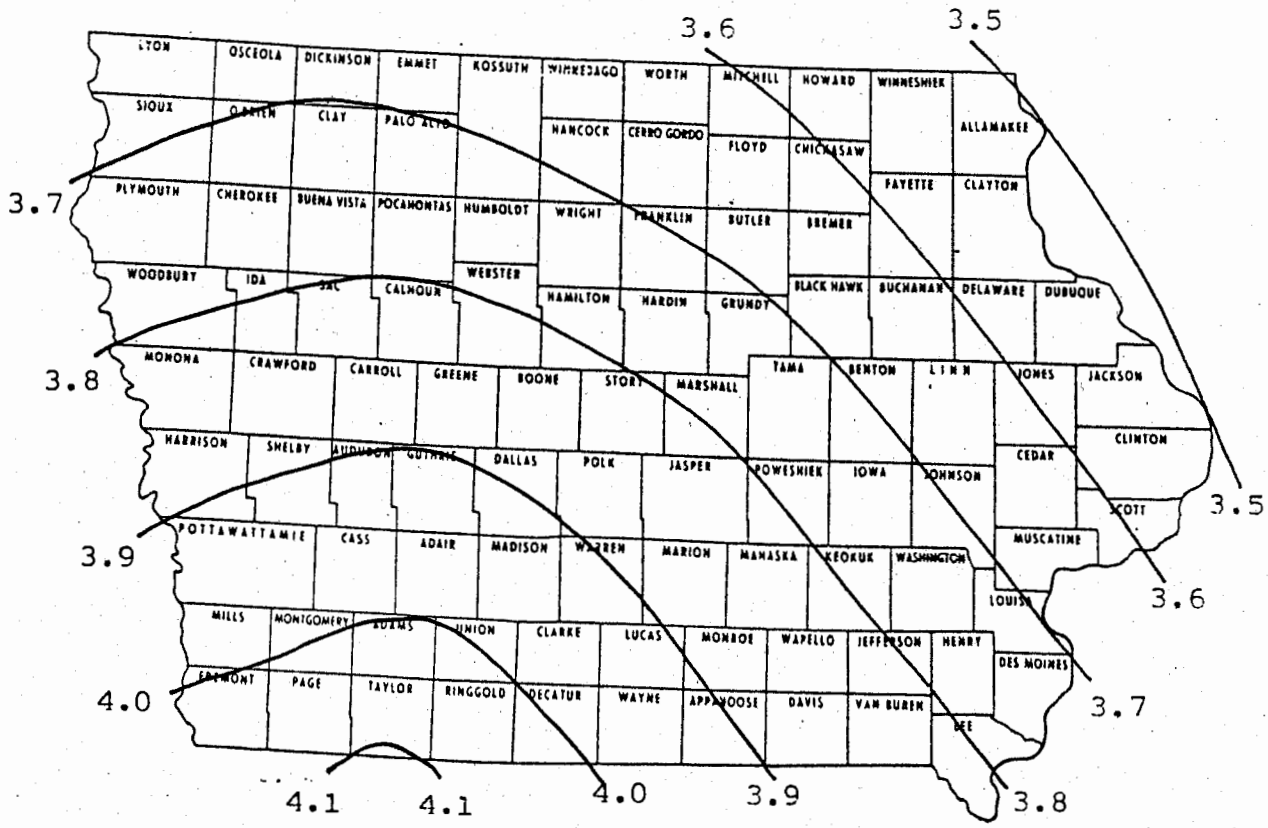

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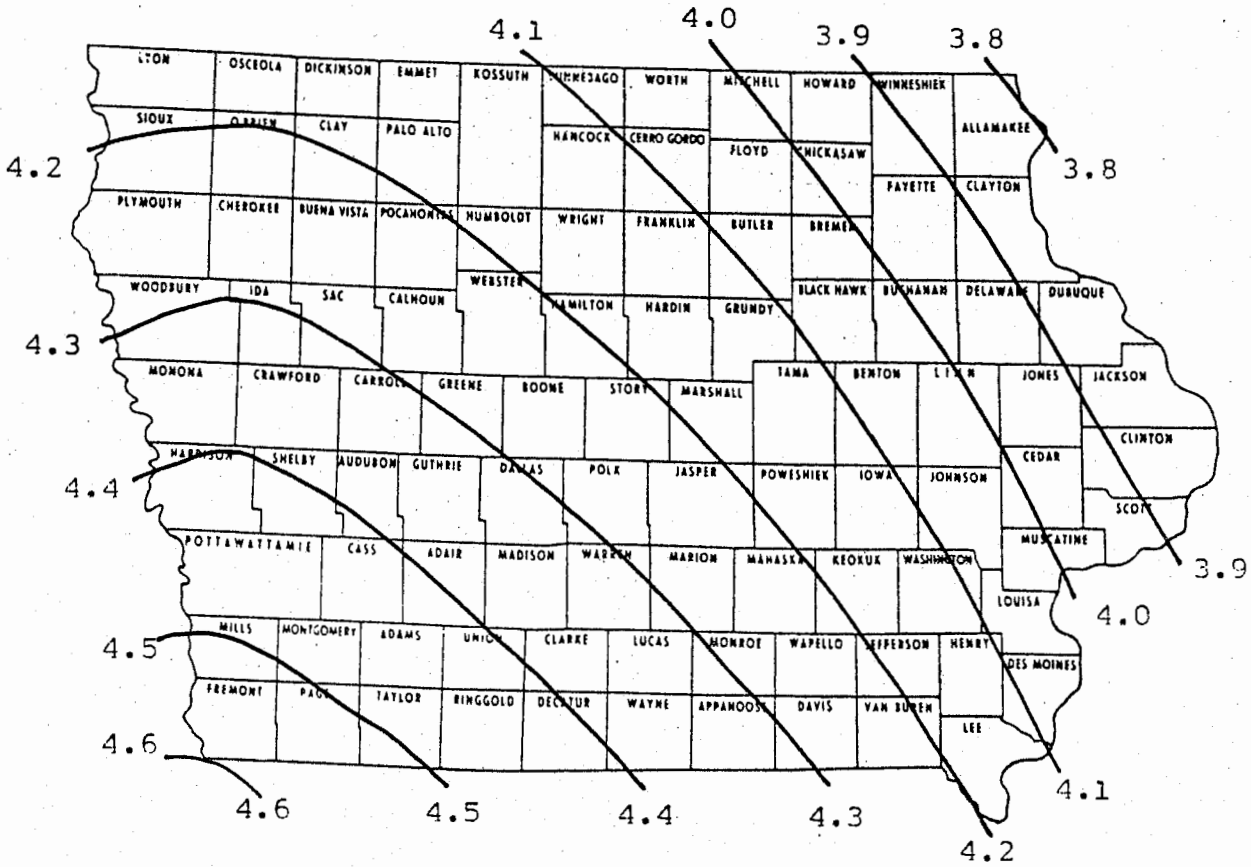
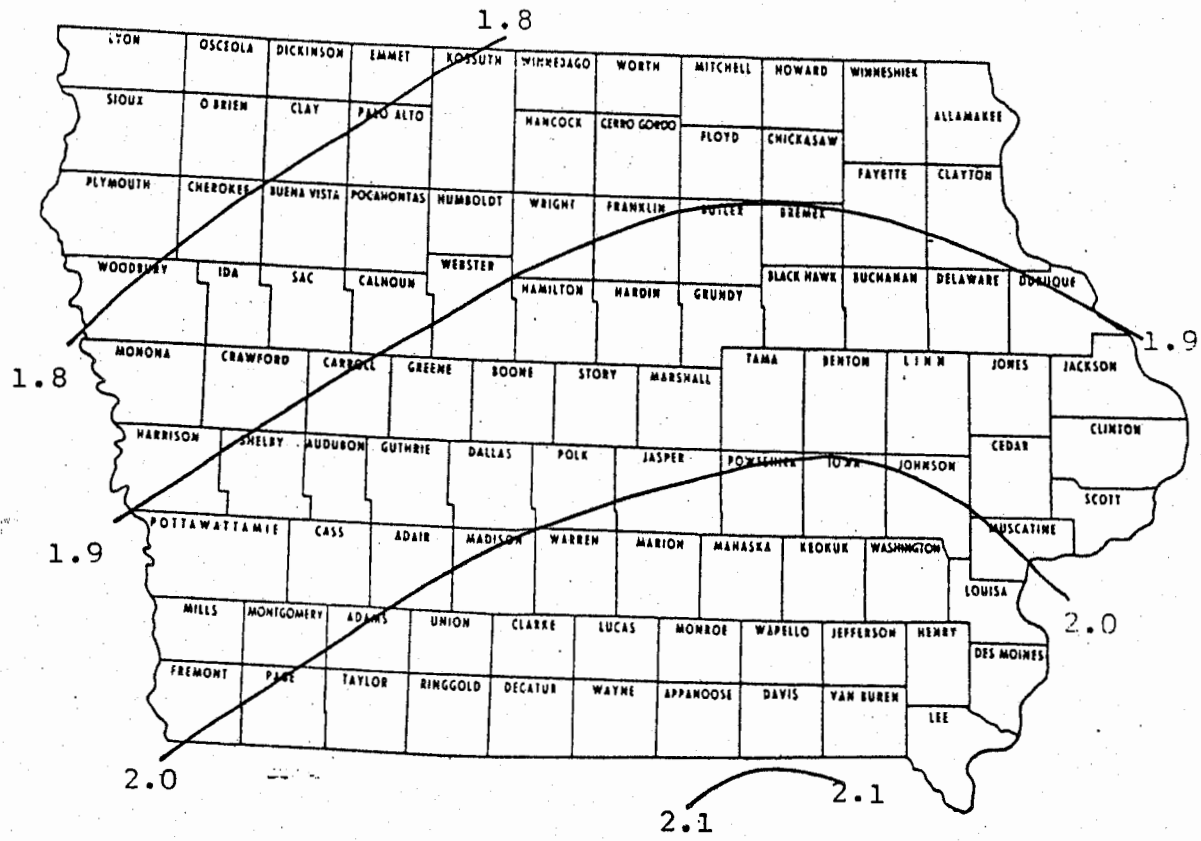


1 - Year 6-Hour Rainfall (Inches)



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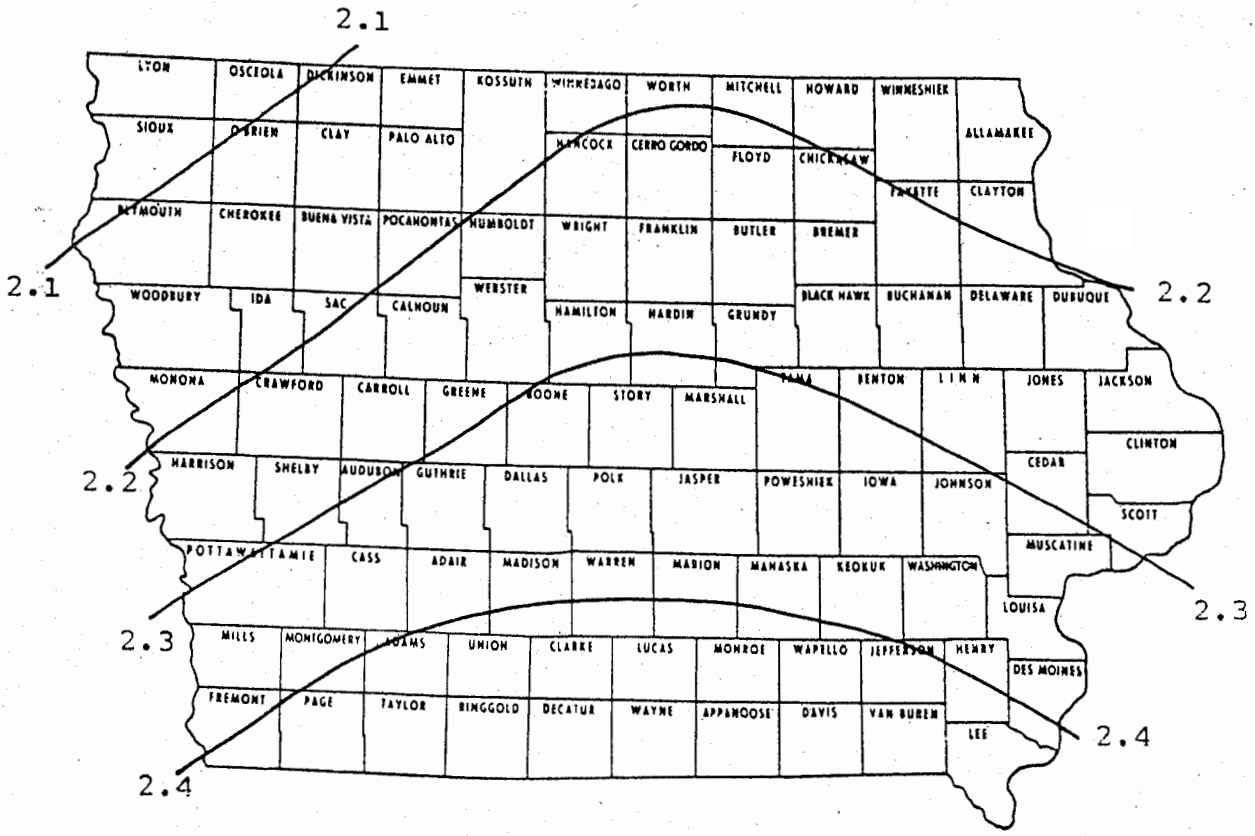

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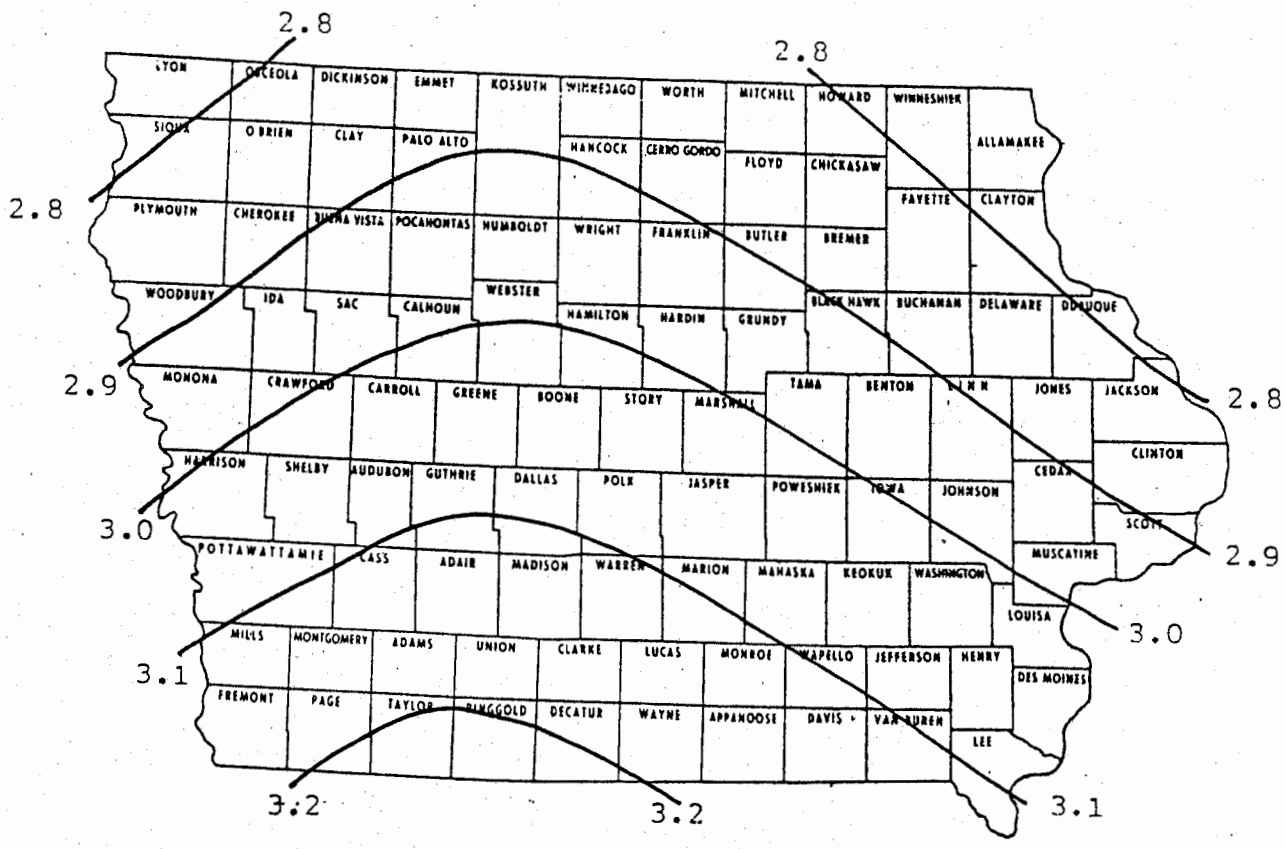

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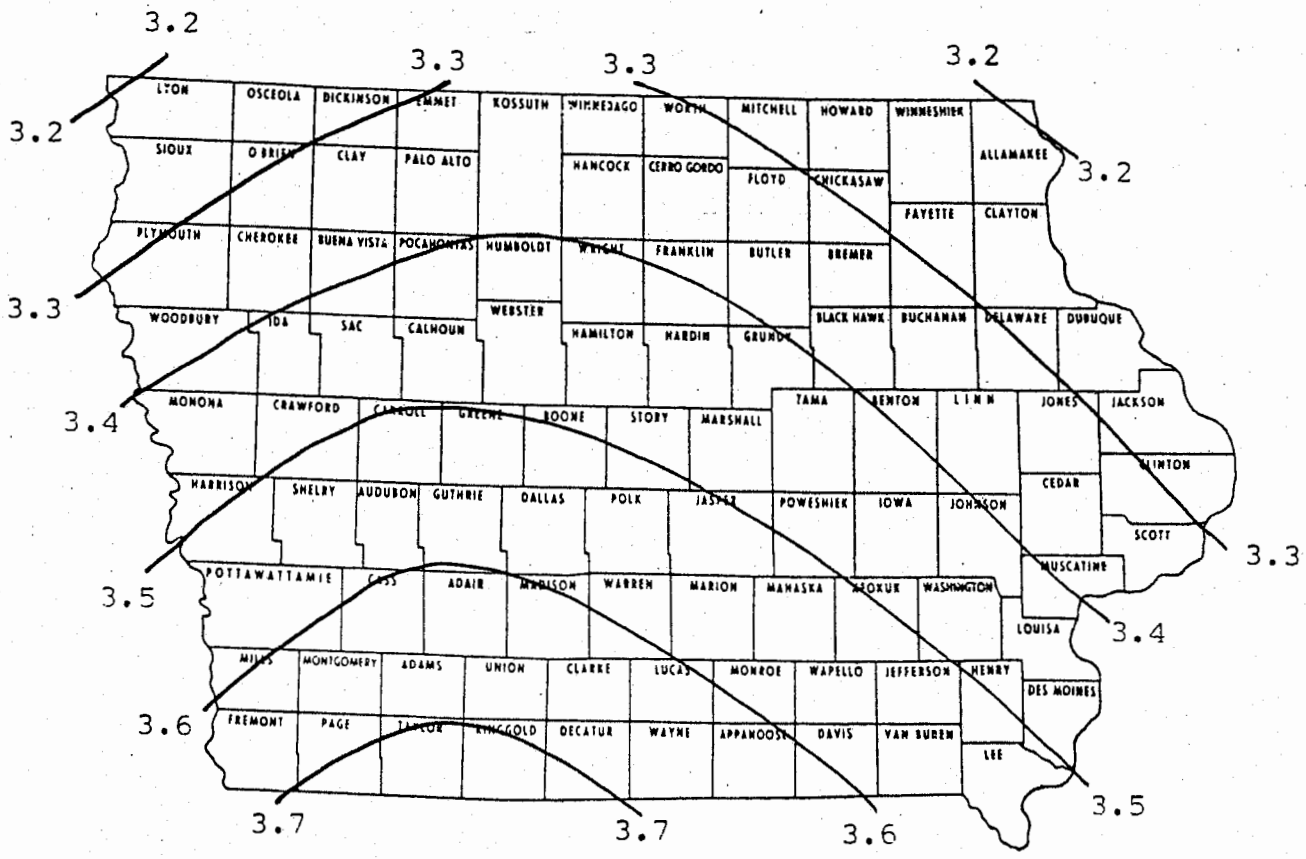
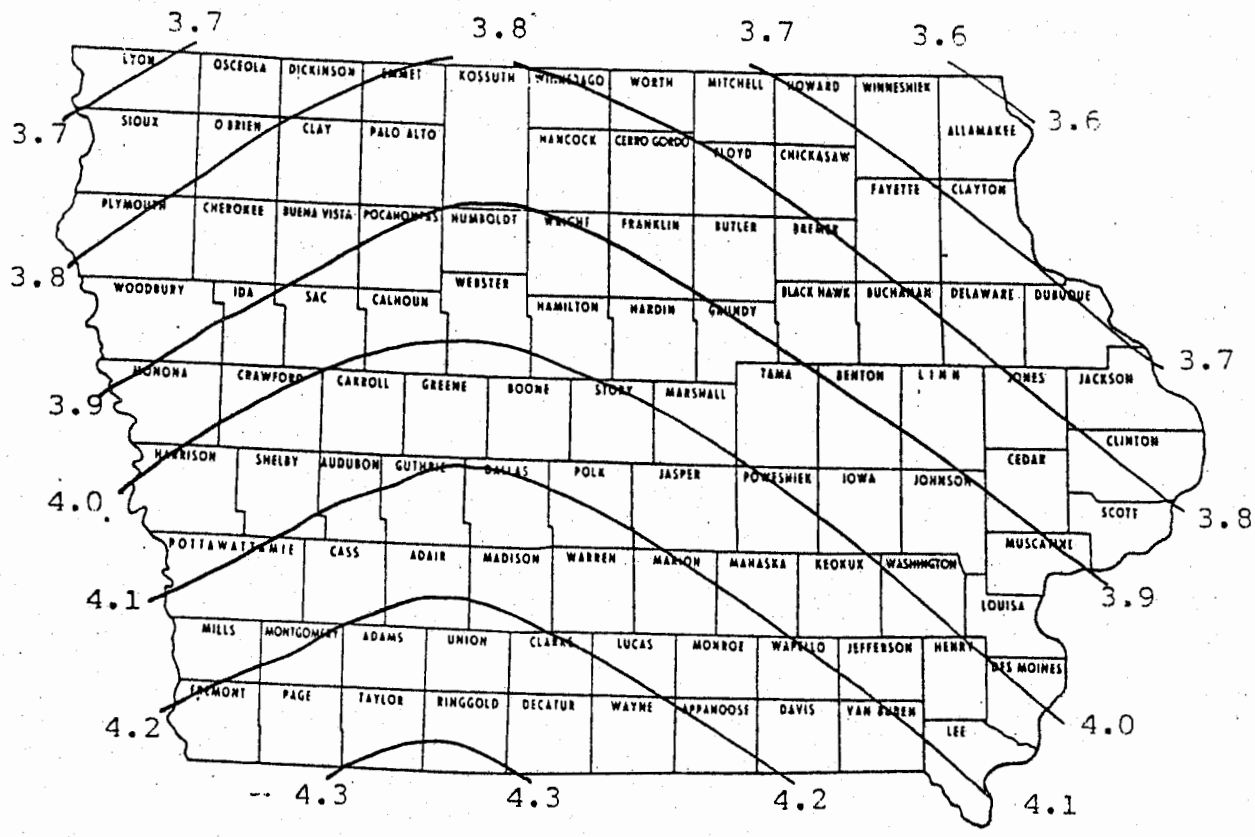
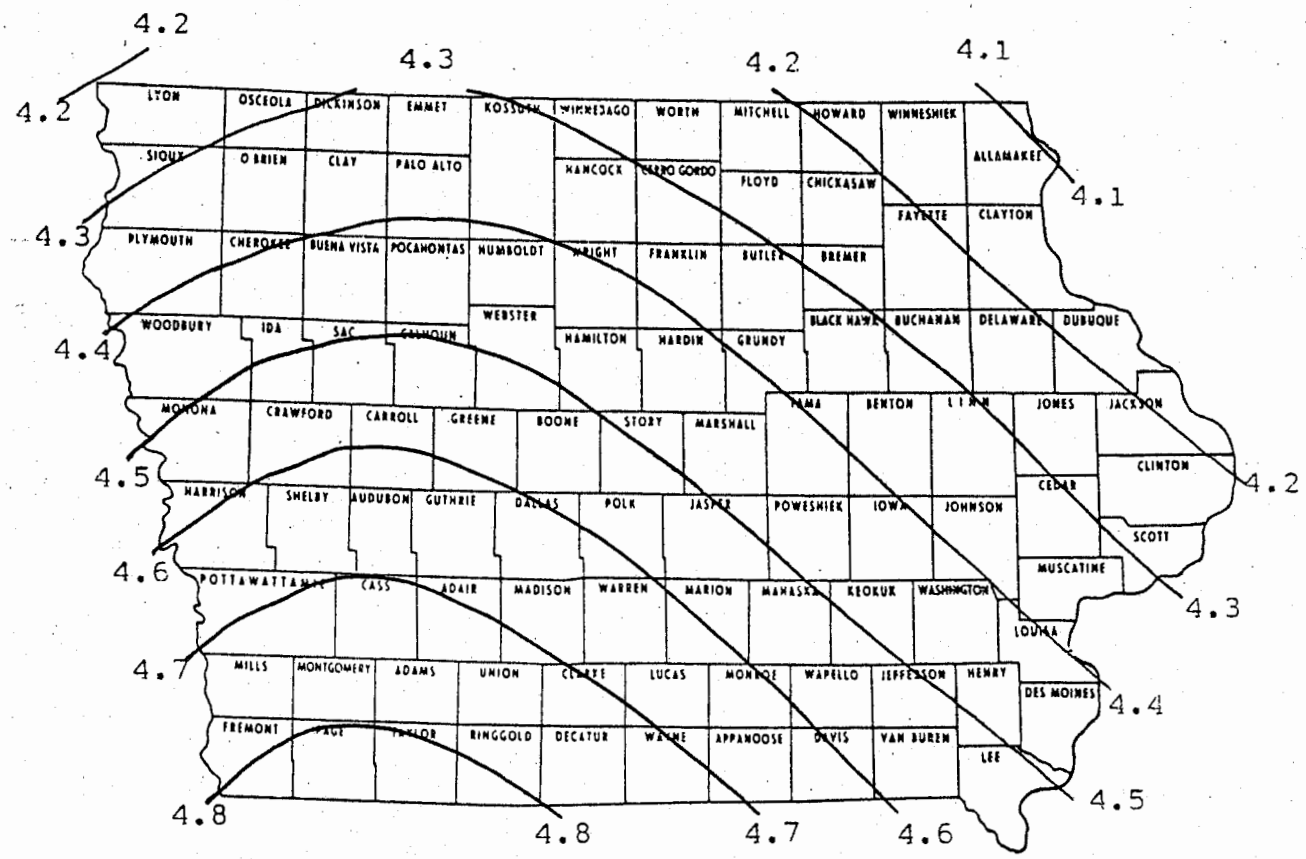


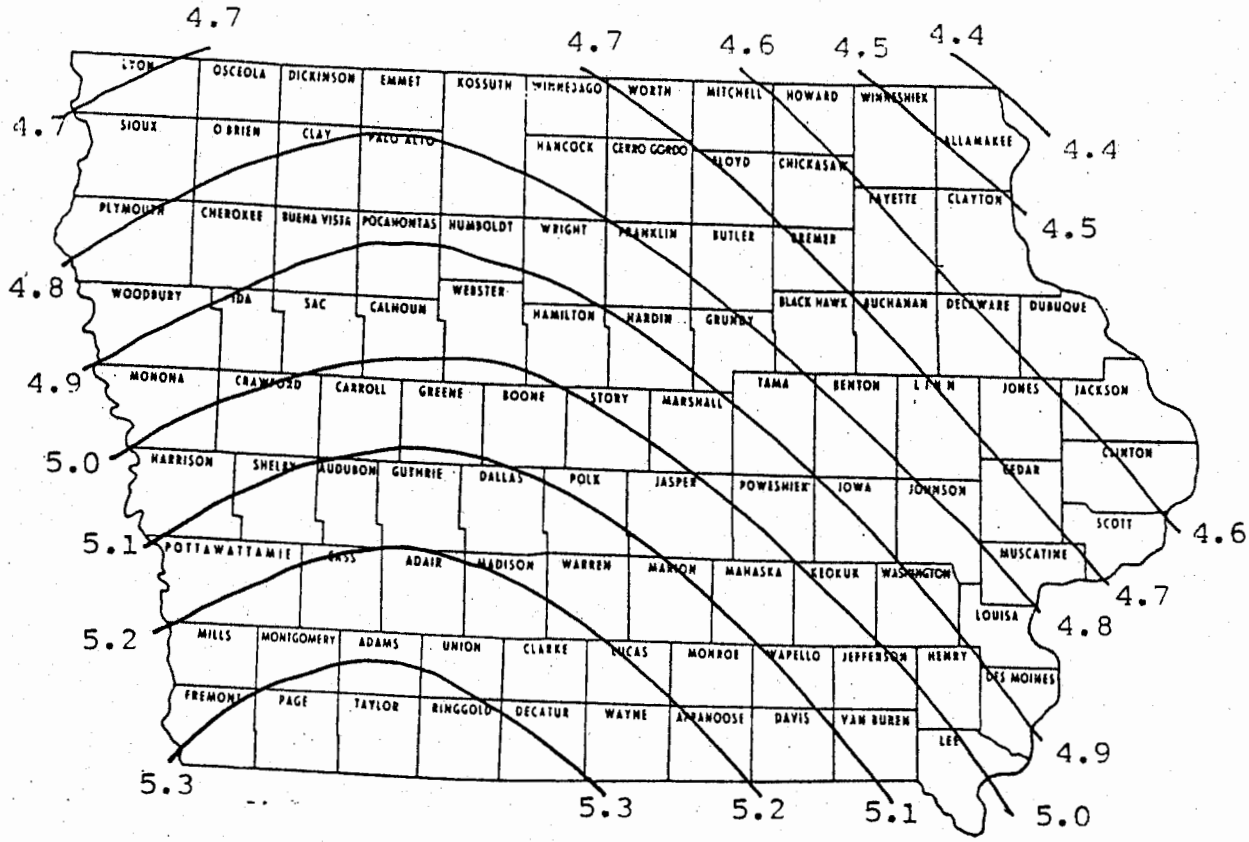
25 - Year 6-Hour Rainfall (Inches)



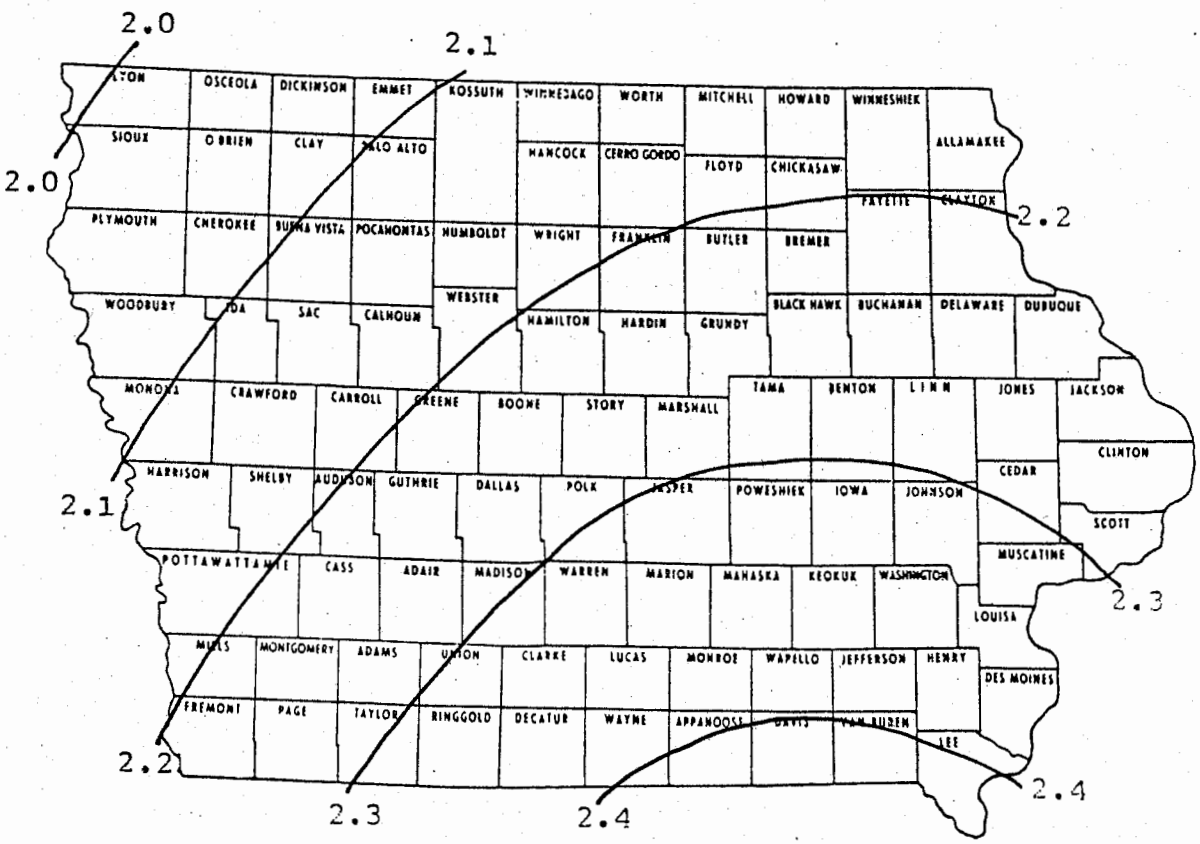
50 - Year 6-Hour Rainfall (Inches)



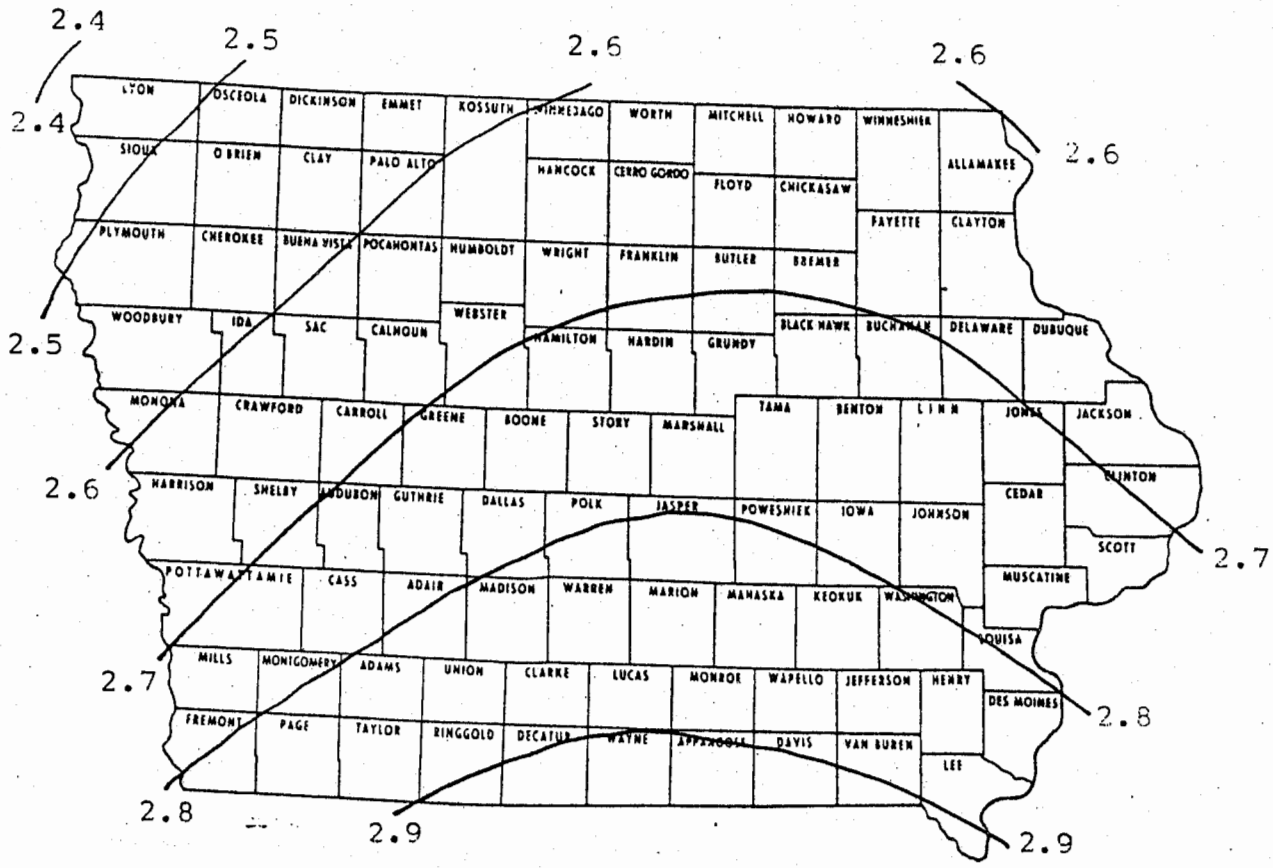
100 - Year 6-Hour Rainfall (Inches)



1 - Year 12-Hour Rainfall (Inches)



2 - Year 12-Hour Rainfall (Inches)



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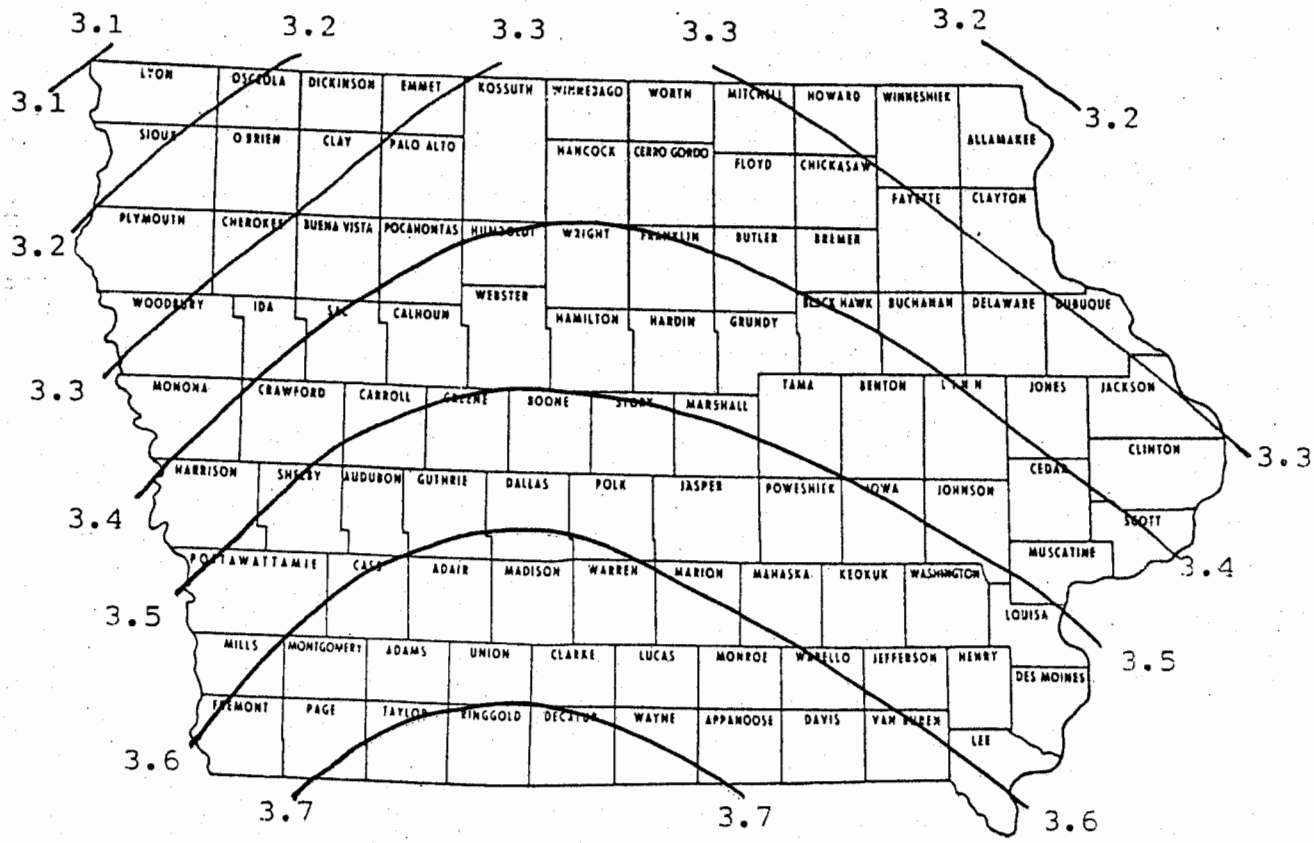
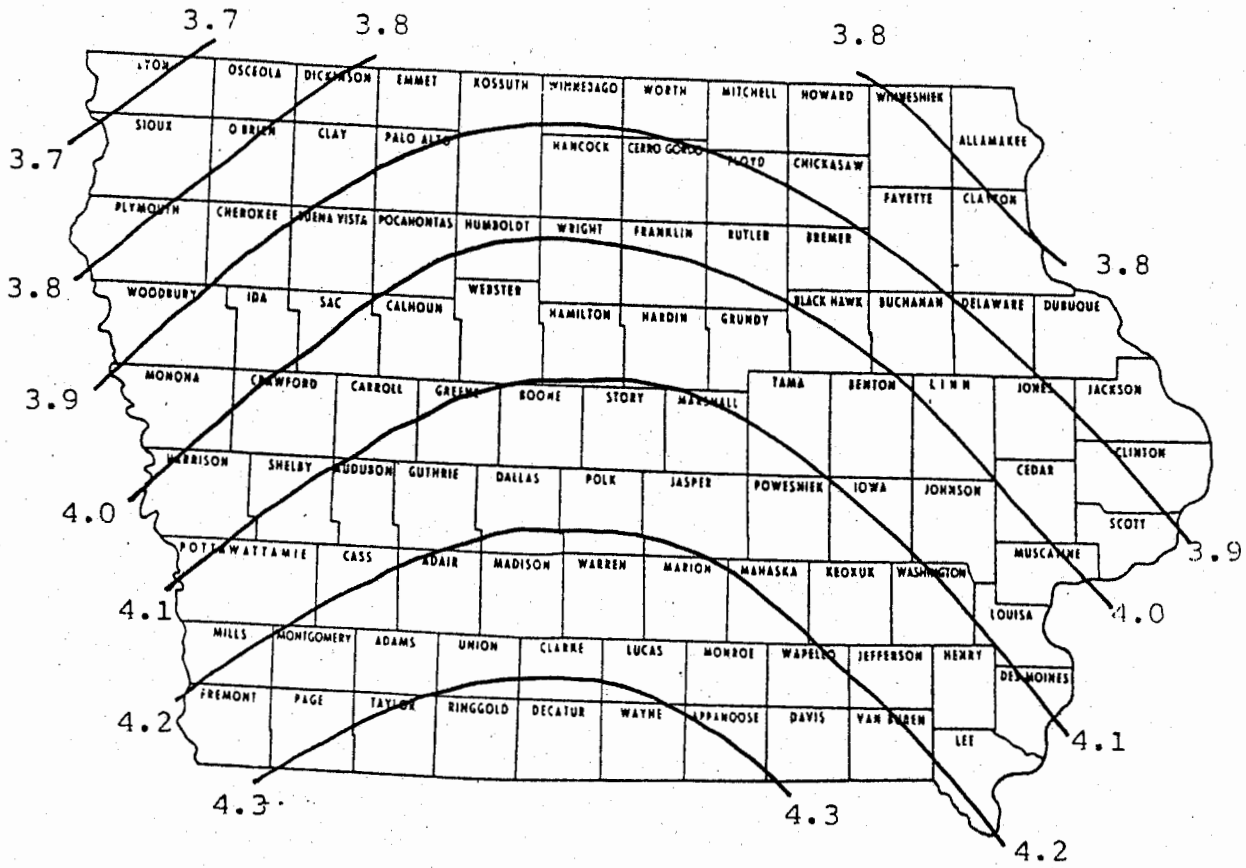
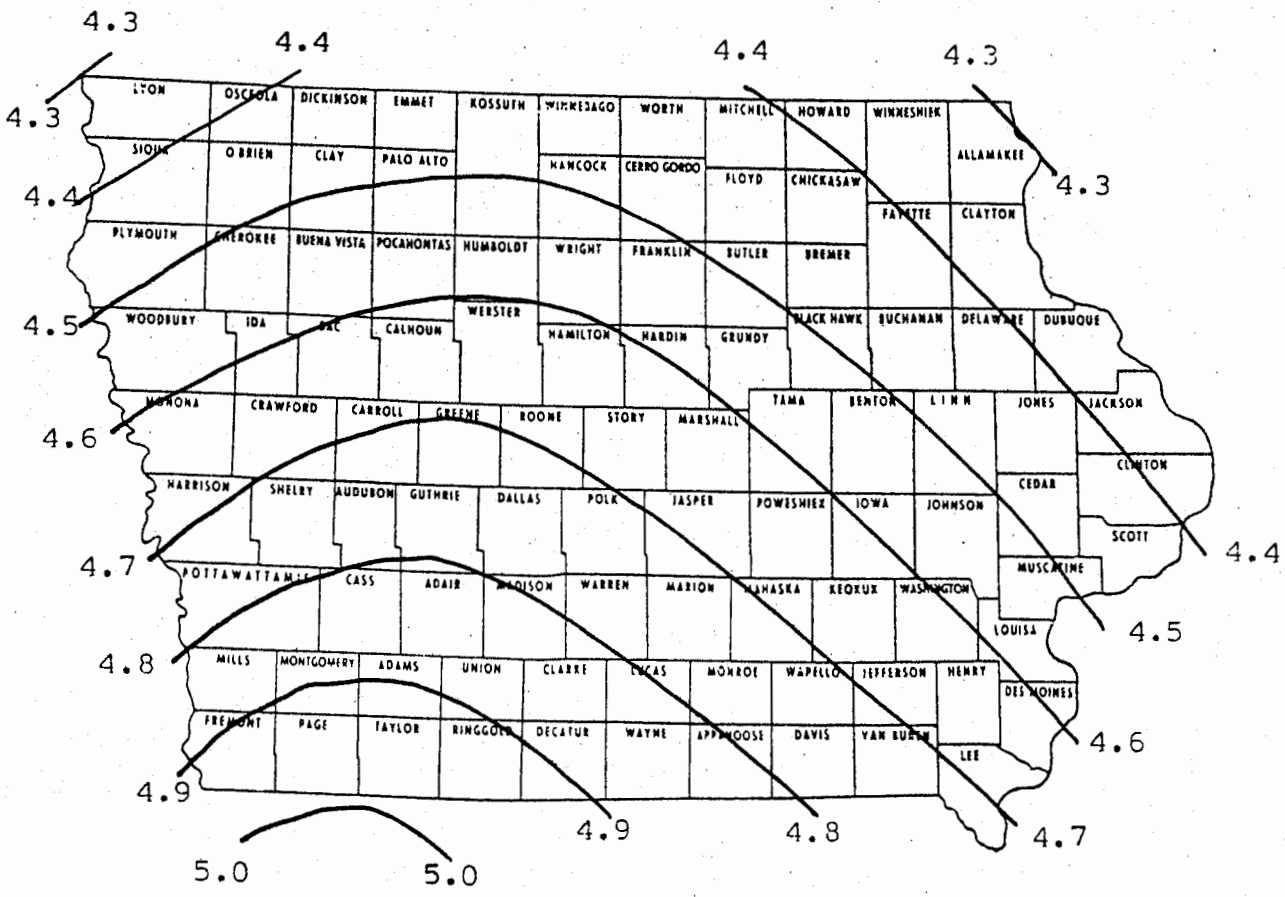


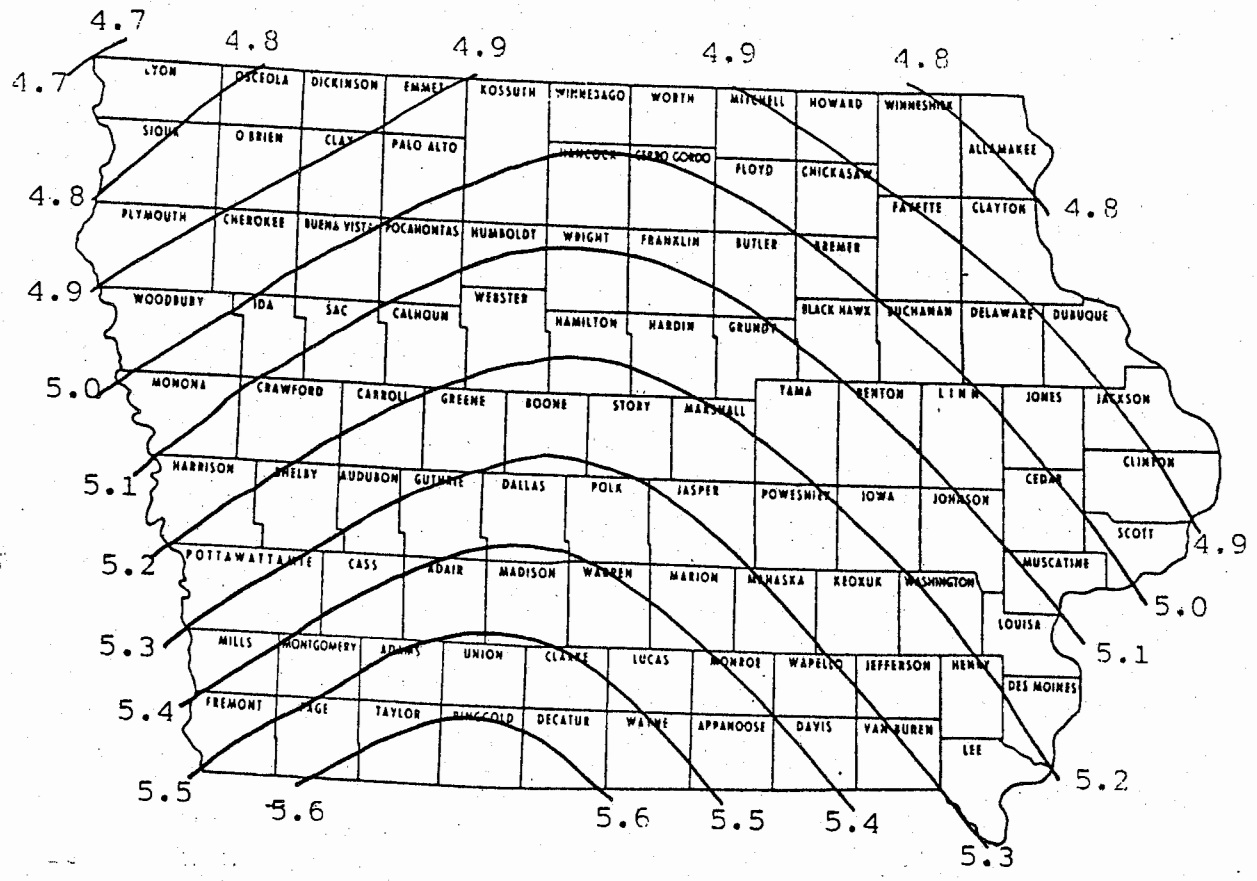
10 - Year 12-Hour Rainfall (Inches)



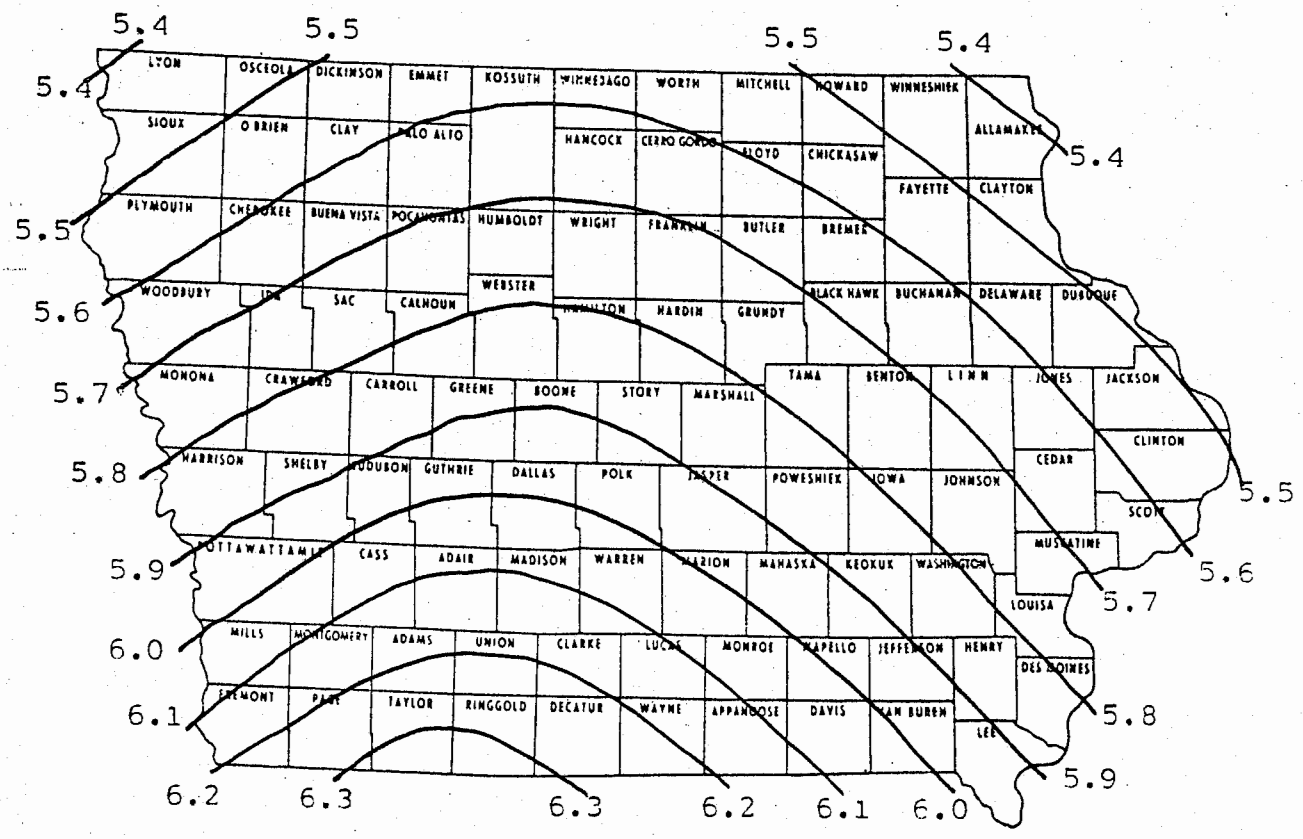
25 - Year 12-Hour Rainfall (Inches)



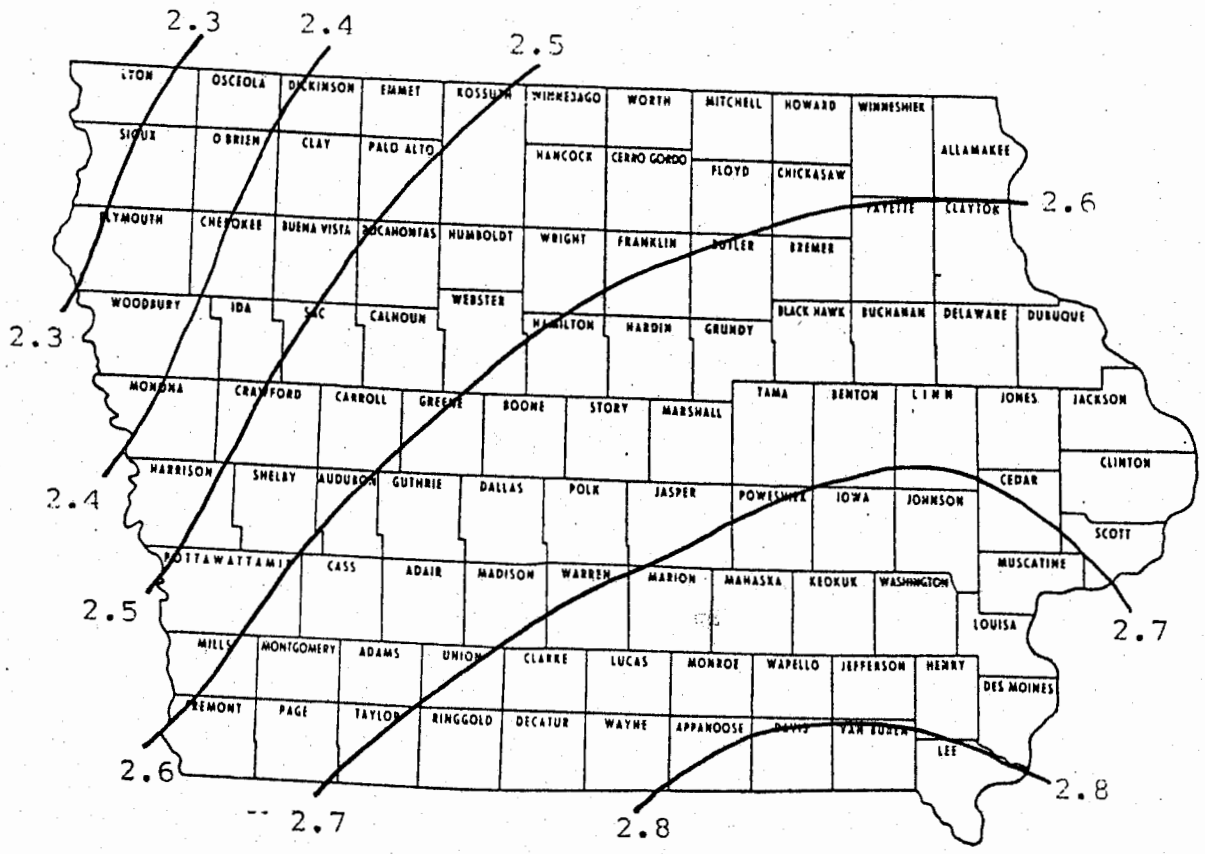
50 - Year 12-Hour Rainfall (Inches)



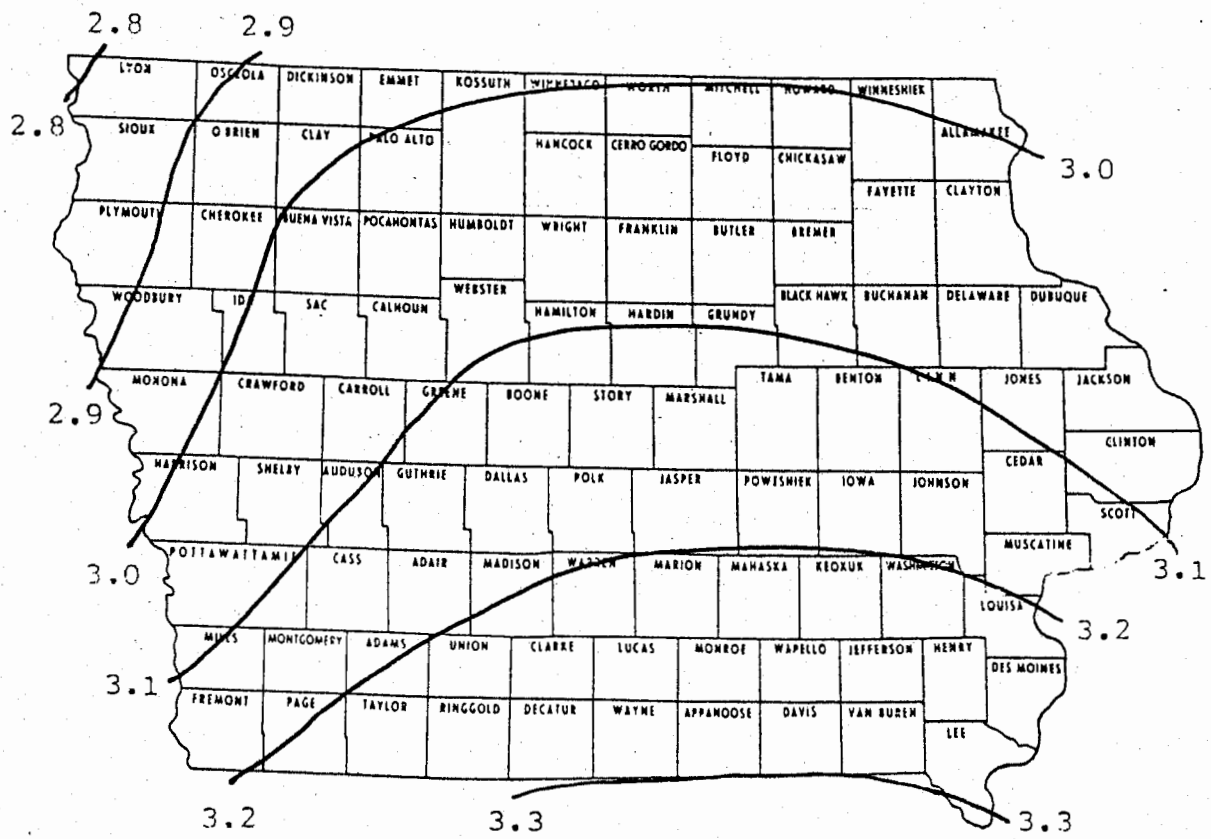
100 - Year 12-Hour Rainfall (Inches)



1 - Year 24-Hour Rainfall (Inches)



2 - Year 24-Hour Rainfall (Inches)



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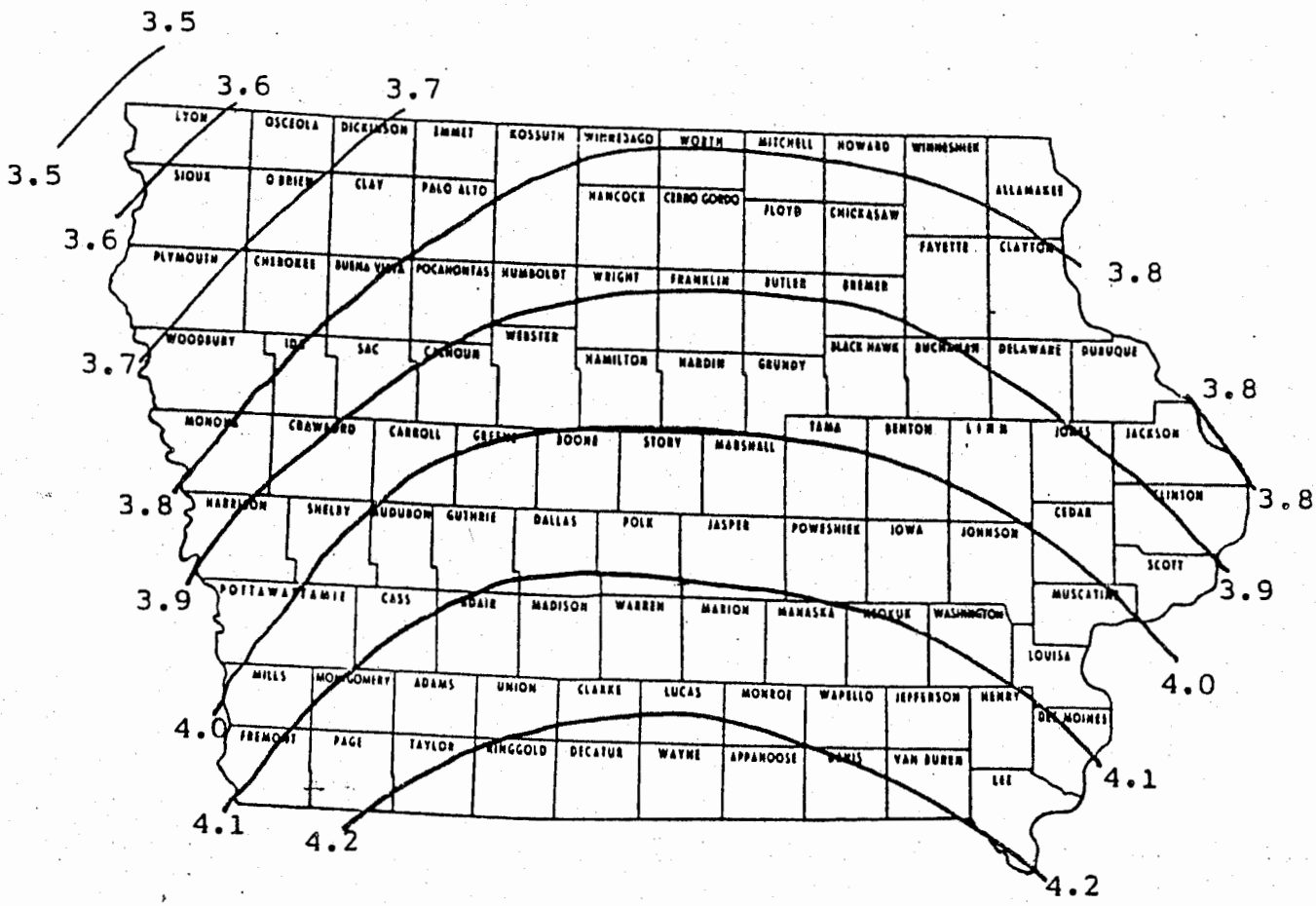
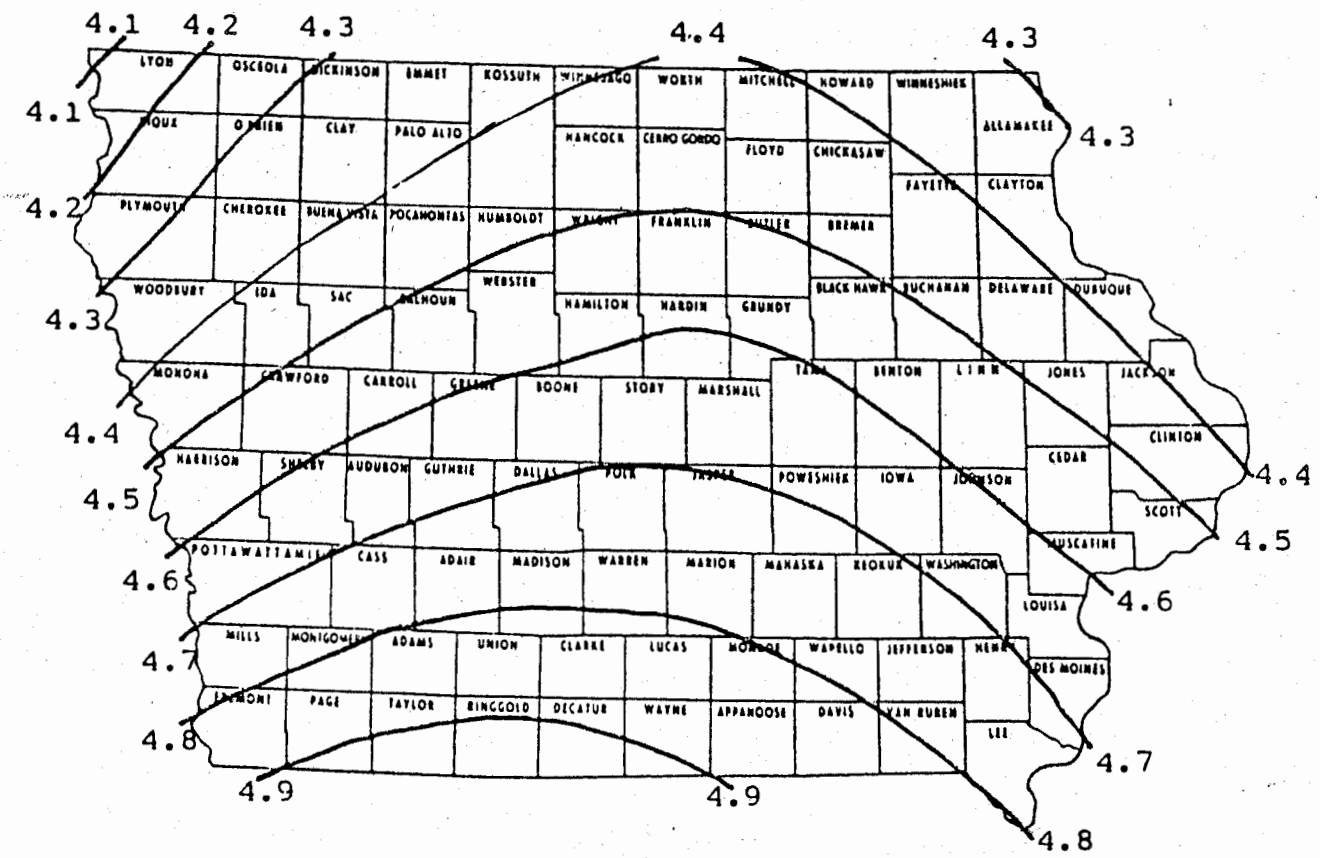
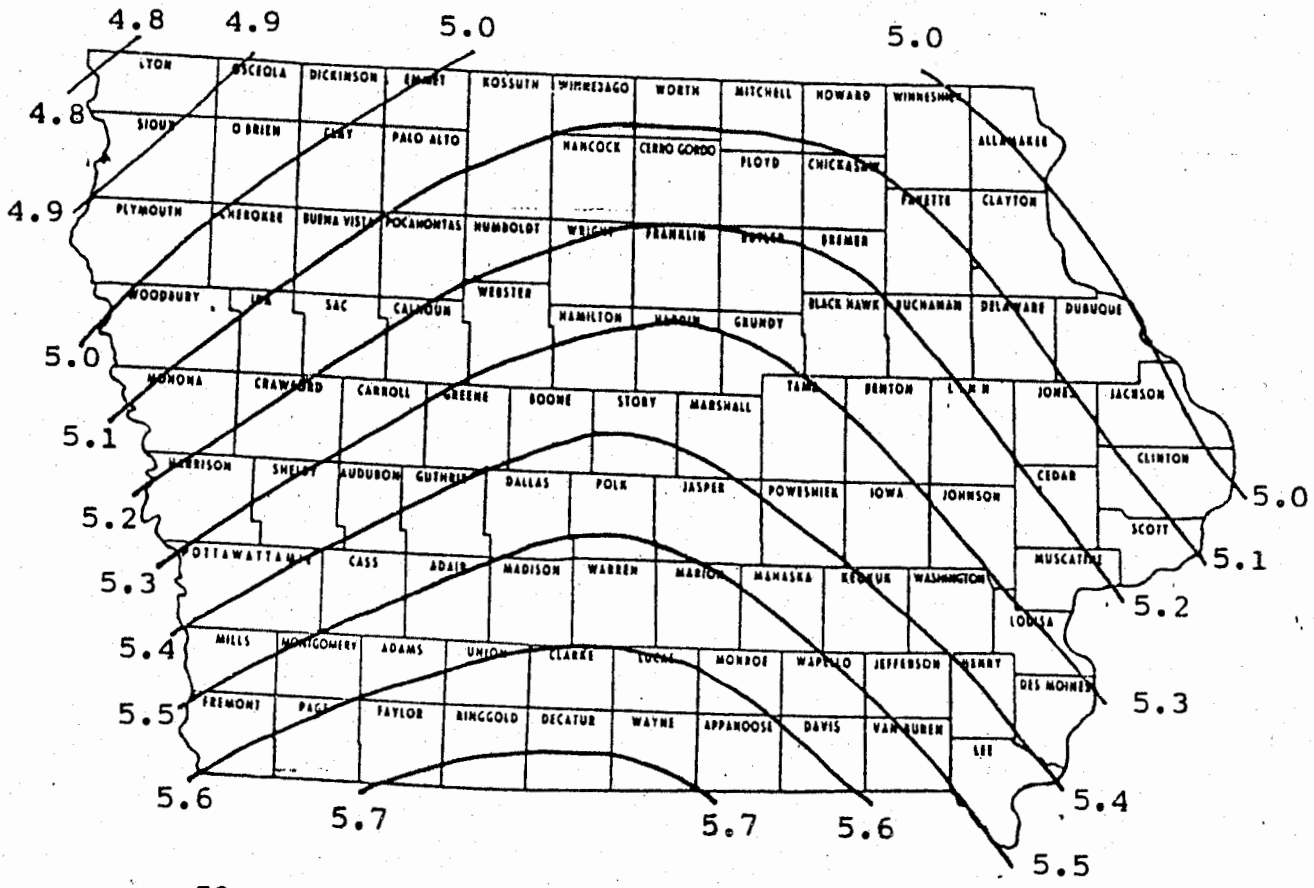


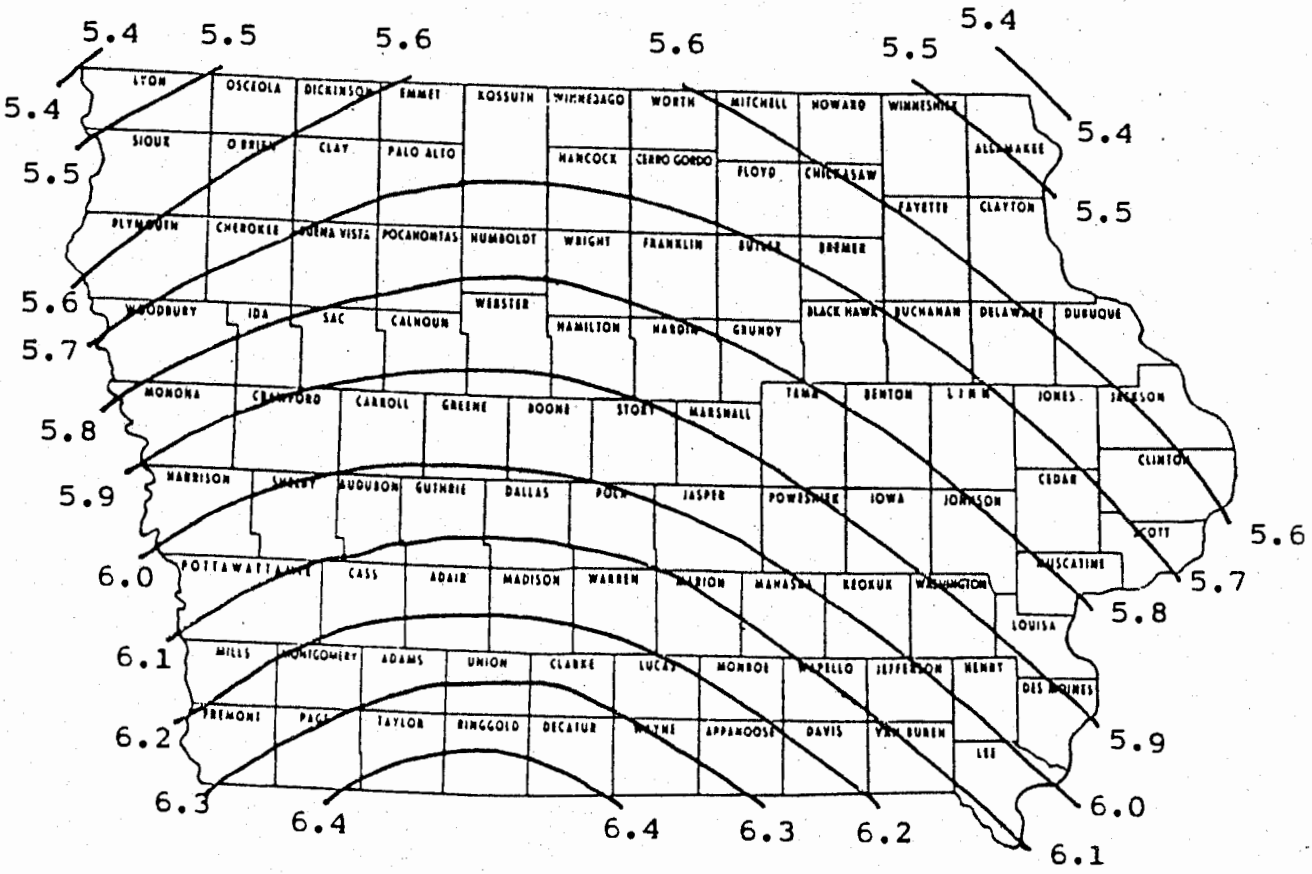
10 - Year 24-Hour Rainfall (Inches)



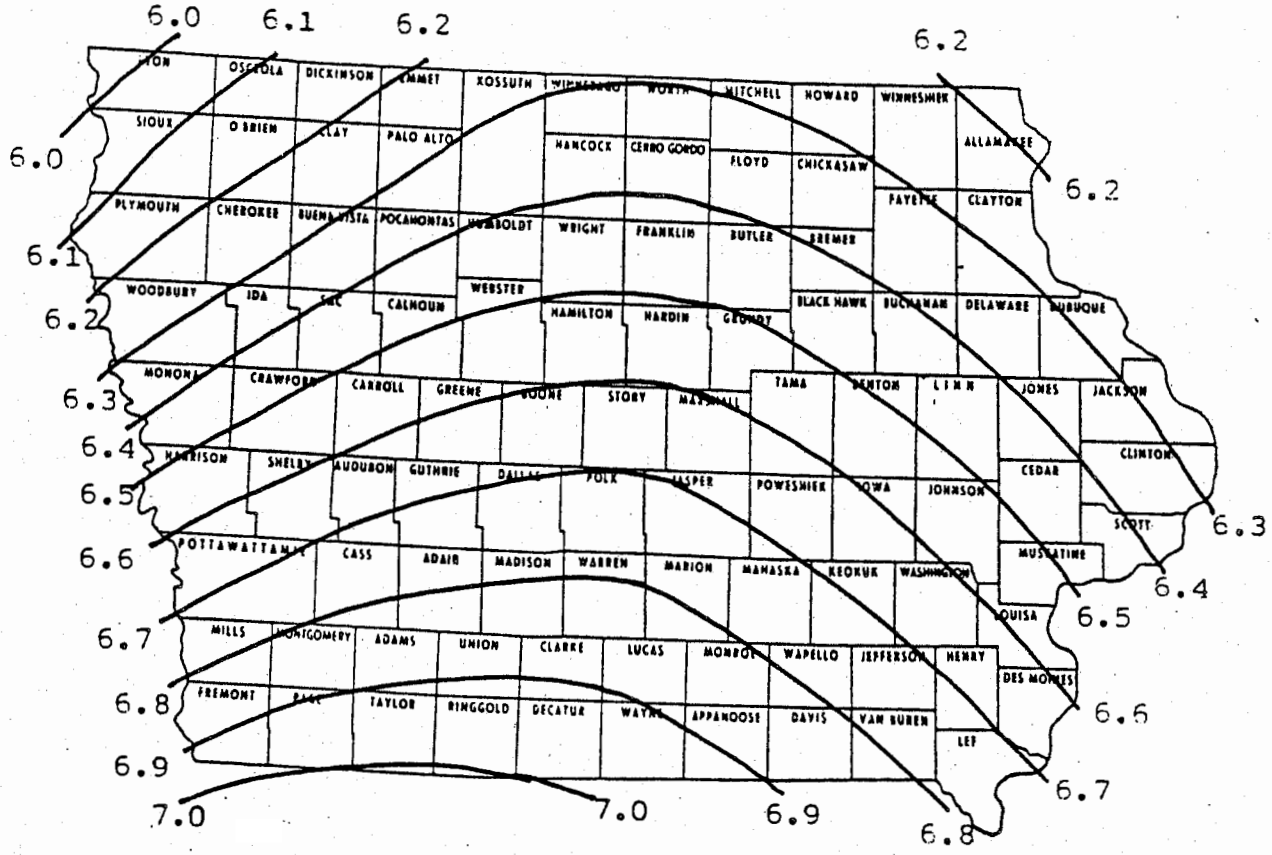
25 - Year 24-Hour Rainfall (Inches)



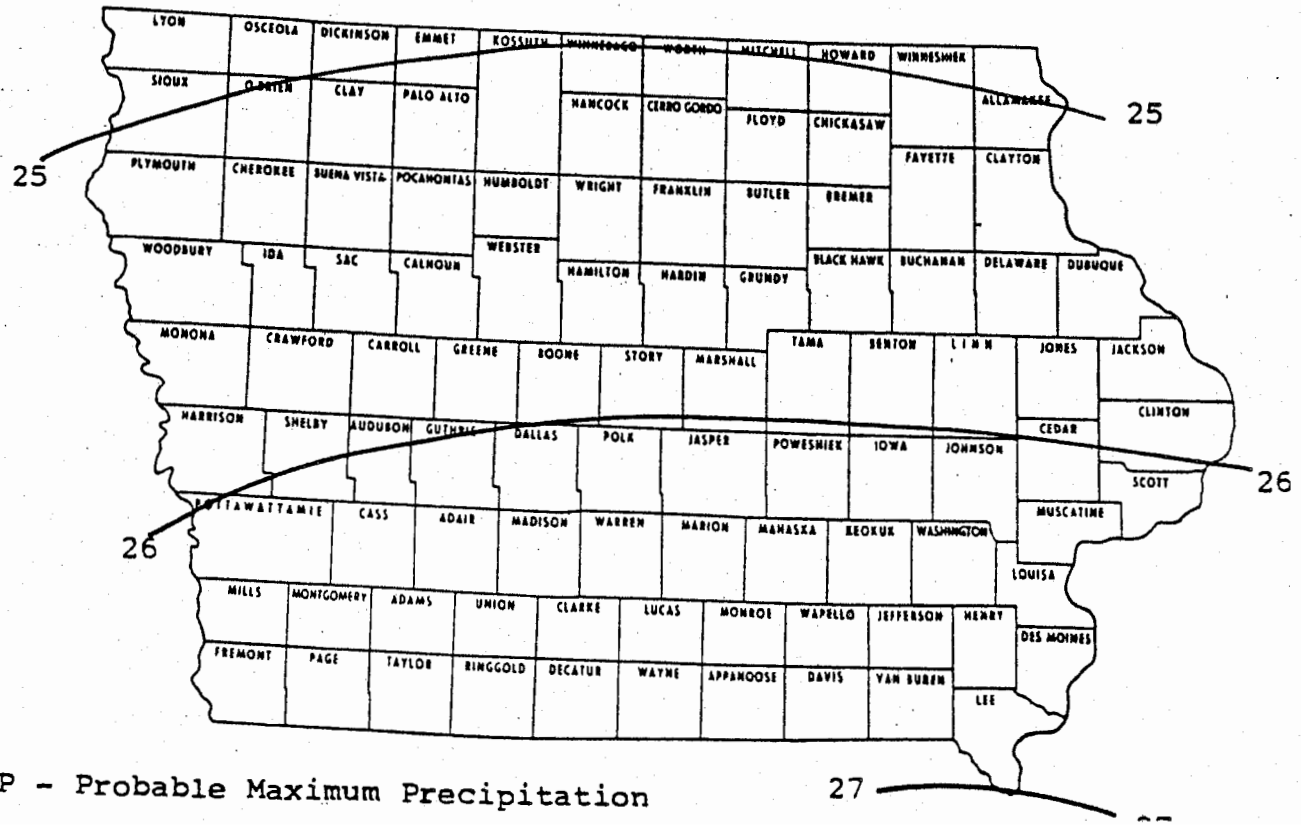
50 - Year 24-Hour Rainfall (Inches)



100 - Year 24-Hour Rainfall (Inches)

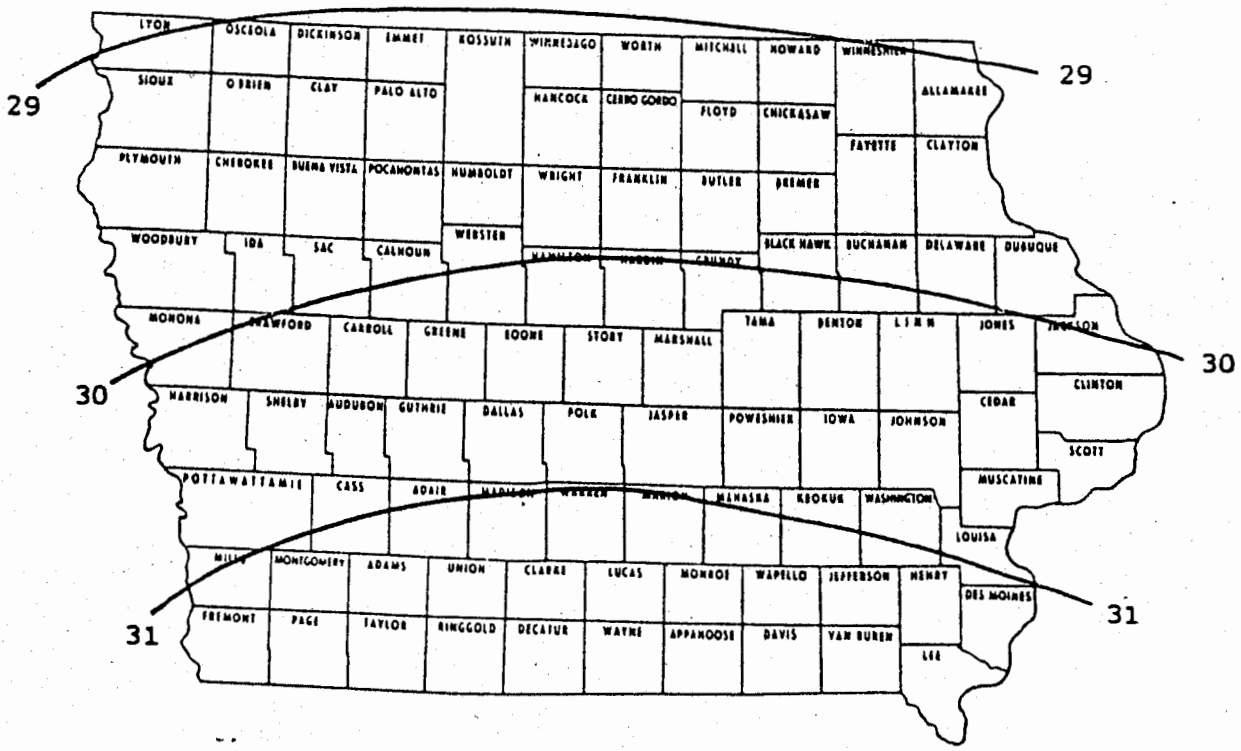


ALL SEASON PMP* (in.) for 6 hr. 10 sq. mi.

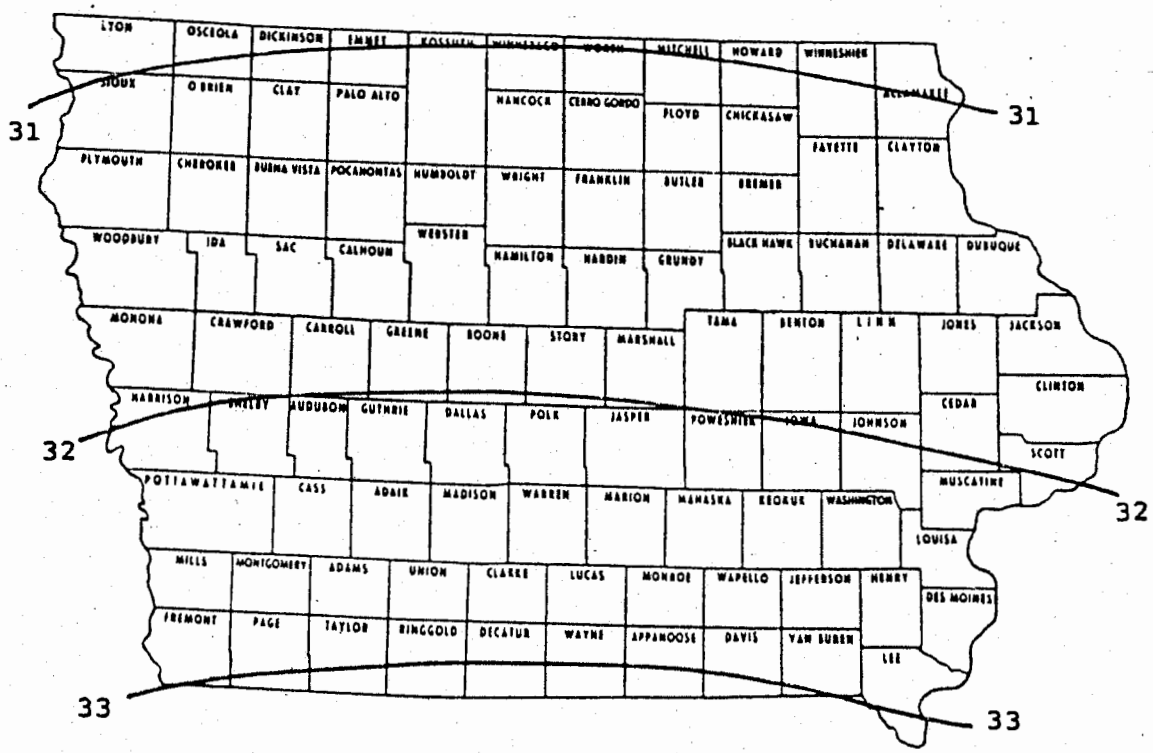


PMP - Probable Maximum Precipitation

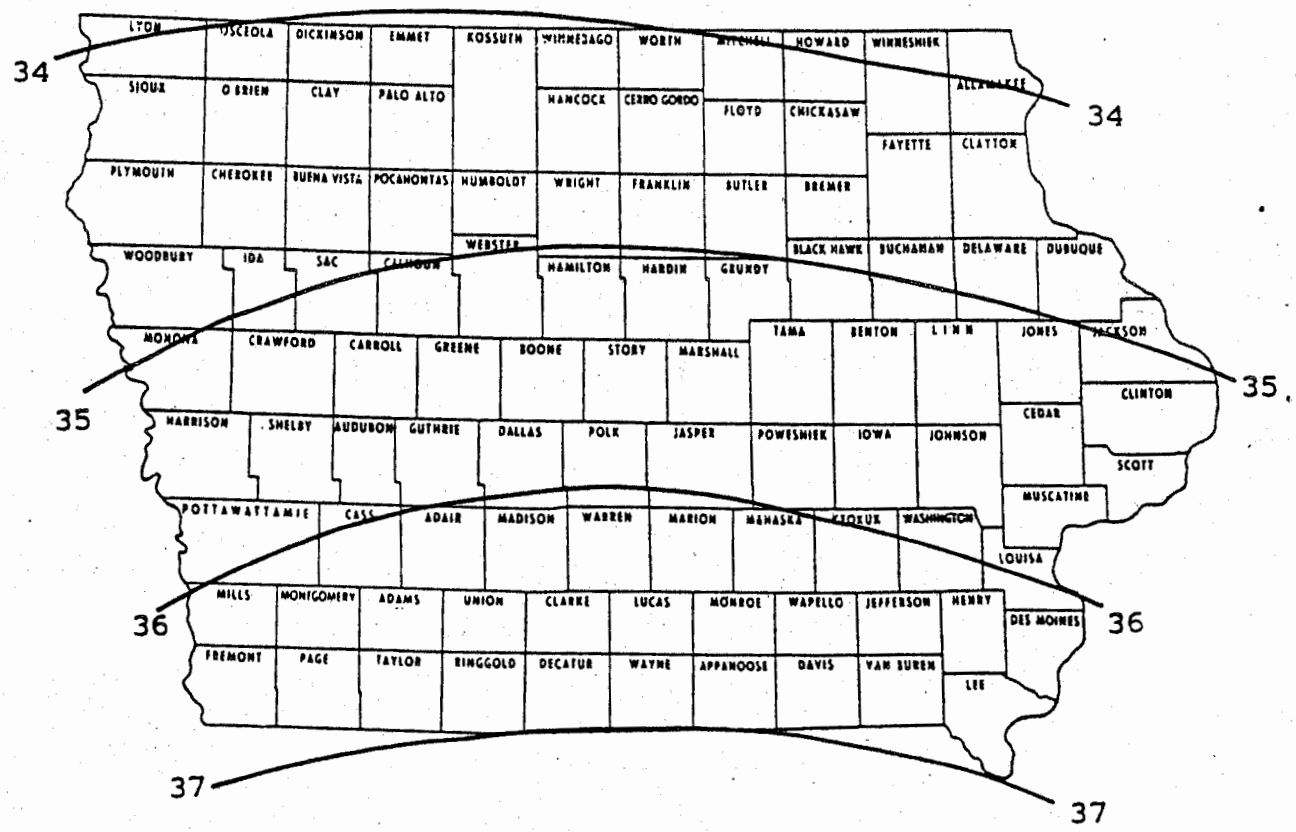
ALL SEASON PMP (in.) for 12 hr. 10 sq. mi.



ALL SEASON PMP (in.) for 24 hr. 10 sq. mi.



ALL SEASON PMP (in.) for 48 hr. 10 sq. mi.



ALL SEASON PMP (in.) for 72 hr. 10 sq. mi.

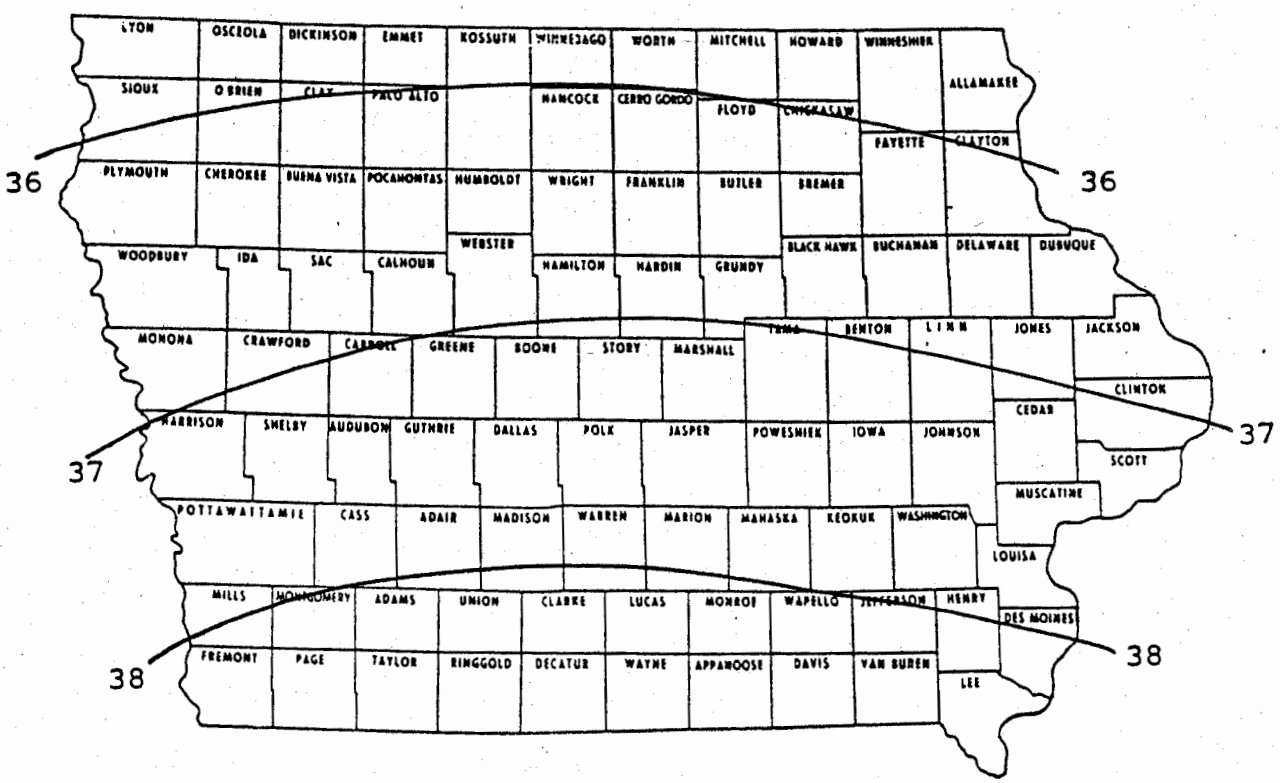


Table 1

ALL-SEASON PROBABLE MAXIMUM PRECIPITATION By area and durations.

Winnebago-Worth Counties

Square Miles	6 hr	12 hr	24 hr	48 hr	72 hr
10	25.0	29.2	31.0	34.0	36.0
200	18.5	21.9	23.7	26.6	28.3
1,000	13.5	16.1	18.0	21.0	22.5
5,000	8.3	10.7	12.3	15.3	17.0
10,000	6.3	8.5	10.1	13.0	14.6
20,000	4.6	6.6	8.0	10.9	12.5

Decatur-Wayne Counties

Square Miles	6 hr	12 hr	24 hr	48 hr	72 hr
10	26.7	31.5	33.0	37.0	38.2
200	19.2	23.2	25.0	28.0	29.9
1,000	14.1	17.5	19.3	22.1	24.1
5,000	8.7	11.4	13.3	16.5	18.0
10,000	6.8	9.1	11.0	14.0	15.7
20,000	4.9	7.1	9.0	11.7	13.2

Table 2

IOWA STORMS: MAXIMUM OBSERVED AREAL RAINFALLS

RAINFALL CENTER - Bonaparte (Van Buren County) DATE: 6/9-10/1905

Maximum Average Depth of Rainfall in Inches

Area Sq. Mi.	Duration of Rainfall in Hours 6	12
10	10.0	12.0
100	9.2	11.5
200	8.9	11.3
1000	8.0	10.0
5000	5.8	7.3
10000	4.4	5.6
20000	3.0	3.9

RAINFALL CENTER - Boyden (Sioux County) DATE: 9/17-19/1926

Maximun Average Depth of Rainfall in Inches

Area Sq. Mi.	Duration of Rainfall in Hours 6	12	18	24	30	36	48
10	15.1	20.7	21.7	21.7	21.7	21.7	21.7
100	12.8	17.1	17.8	17.8	17.8	17.8	17.8
200	11.7	15.8	16.6	16.6	16.6	16.6	16.6
1000	7.5	10.1	10.4	10.6	10.6	10.6	10.6
5000	4.1	6.3	6.4	6.6	6.6	6.6	6.6
10000	3.0	5.2	5.4	5.5	5.6	5.6	5.6
20000	2.1	4.1	4.3	4.4	4.6	4.8	4.9
50000	1.4	2.7	2.9	3.0	3.2	3.6	3.8

RAINFALL FREQUENCIES FOR BLACK HAWK COUNTY, IOWA FOR DURATIONS FROM 30 MINUTES TO 24 HOURS AND RETURN PERIODS FROM 1 TO 100 YEARS (Adapted from the U. S. Department of Commerce Weather Bureau Technical Paper No. 40)

Return Period Years	30 Min.	1 Hr.	2 Hrs.	3 Hrs.	6 Hrs.	12 Hrs.	24 Hr
1	1.0	1.3	1.5	1.7	1.9	2.2	2.7
2	1.2	1.6	1.8	2.0	2.3	2.7	3.1
5	1.5	2.0	2.3	2.5	2.9	3.4	4.0
10	1.8	2.2	2.6	2.9	3.4	4.0	4.6
25	2.0	2.6	3.0	3.3	3.9	4.5	5.3
50	2.2	2.8	3.4	3.7	4.4	5.1	5.8
100	2.5	3.1	3.8	4.1	4.8	5.7	6.5

RAINFALL FREQUENCIES FOR BLACK HAWK COUNTY, IOWA FOR DURATIONS FROM 2 TO 10 DAY PRECIPITATION FOR RETURN PERIODS OF 2 TO 100 YEARS (Adapted from the U. S. Department of Commerce Weather Bureau Technical Paper No. 49)

Return Period Years	2 Days	4 Days	7 Days	10 Days
2	3.7	4.3	4.9	5.5
5	4.5	5.4	6.3	6.8
10	5.3	6.3	7.2	8.0
25	6.3	7.5	8.6	9.5
50	6.8	8.3	9.5	11.0
100	7.5	9.2	10.8	11.6

RAINFALL FREQUENCIES FOR LINN COUNTY, IOWA FOR DURATIONS FROM 30 MINUTES TO 24 HOURS AND RETURN PERIODS FROM 1 TO 100 YEARS (Adapted from the U. S. Department of Commerce Weather Bureau Technical Paper No. 40)

Return Period Years	30 Min.	1 Hr.	2 Hrs.	3 Hrs.	6 Hrs.	12 Hrs.	24 Hrs.
1	1.0	1.3	1.5	1.7	2.0	2.3	2.7
2	1.2	1.5	1.8	2.0	2.3	2.8	3.1
5	1.5	2.0	2.3	2.5	3.0	3.5	4.0
10	1.8	2.2	2.6	2.9	3.4	4.0	4.6
25	2.0	2.5	3.0	3.3	3.9	4.5	5.3
50	2.2	2.8	3.3	3.7	4.4	5.1	5.8
100	2.5	3.1	3.8	4.1	4.8	5.7	6.5

RAINFALL FREQUENCIES FOR LINN COUNTY, IOWA FOR DURATIONS FROM 2 TO 10 DAY PRECIPITATION FOR RETURN PERIODS OF 2 TO 100 YEARS (Adapted from the U. S. Department of Commerce Weather Bureau Technical Paper No. 49)

Return Period Years	2 Days	4 Days	7 Days	10 Days
2	3.7	4.3	4.9	5.5
5	4.5	5.4	6.3	6.8
10	5.3	6.3	7.2	8.0
25	6.3	7.5	8.6	9.5
50	6.8	8.3	9.5	11.0
100	7.5	9.2	10.8	11.6

RAINFALL FREQUENCIES FOR POLK COUNTY, IOWA FOR DURATIONS FROM 30 MINUTES TO 24 HOURS AND RETURN PERIODS FROM 1 TO 100 YEARS (Adapted from the U. S. Department of Commerce Weather Bureau Technical Paper No. 40)

Return Period Years	30 Min.	1 Hr.	2 Hrs.	3 Hrs.	6 Hrs.	12 Hrs.	24 Hrs.
1	1.1	1.3	1.6	1.7	2.0	2.4	2.7
2	1.3	1.6	1.9	2.1	2.3	2.8	3.2
5	1.6	2.0	2.4	2.6	3.1	3.6	4.1
10	1.9	2.4	2.8	3.0	3.6	4.2	4.7
25	2.2	2.7	3.2	3.5	4.1	4.7	5.5
50	2.4	3.0	3.6	3.9	4.6	5.4	6.0
100	2.7	3.4	4.0	4.3	5.1	6.0	6.7

RAINFALL FREQUENCIES FOR POLK COUNTY, IOWA FOR DURATIONS FROM 2 to 10 DAY PRECIPITATION FOR RETURN PERIODS OF 2 TO 100 YEARS (Adapted from the U. S. Department of Commerce Weather Bureau Technical Paper No. 49)

Return Period Years	2 Days	4 Days	7 Days	10 Days
2	3.7	4.5	5.1	5.7
5	4.7	5.6	6.4	7.0
10	5.5	6.5	7.3	8.3
25	6.5	7.7	8.7	9.7
50	7.1	8.5	9.7	11.1
100	7.8	9.3	11.0	11.8

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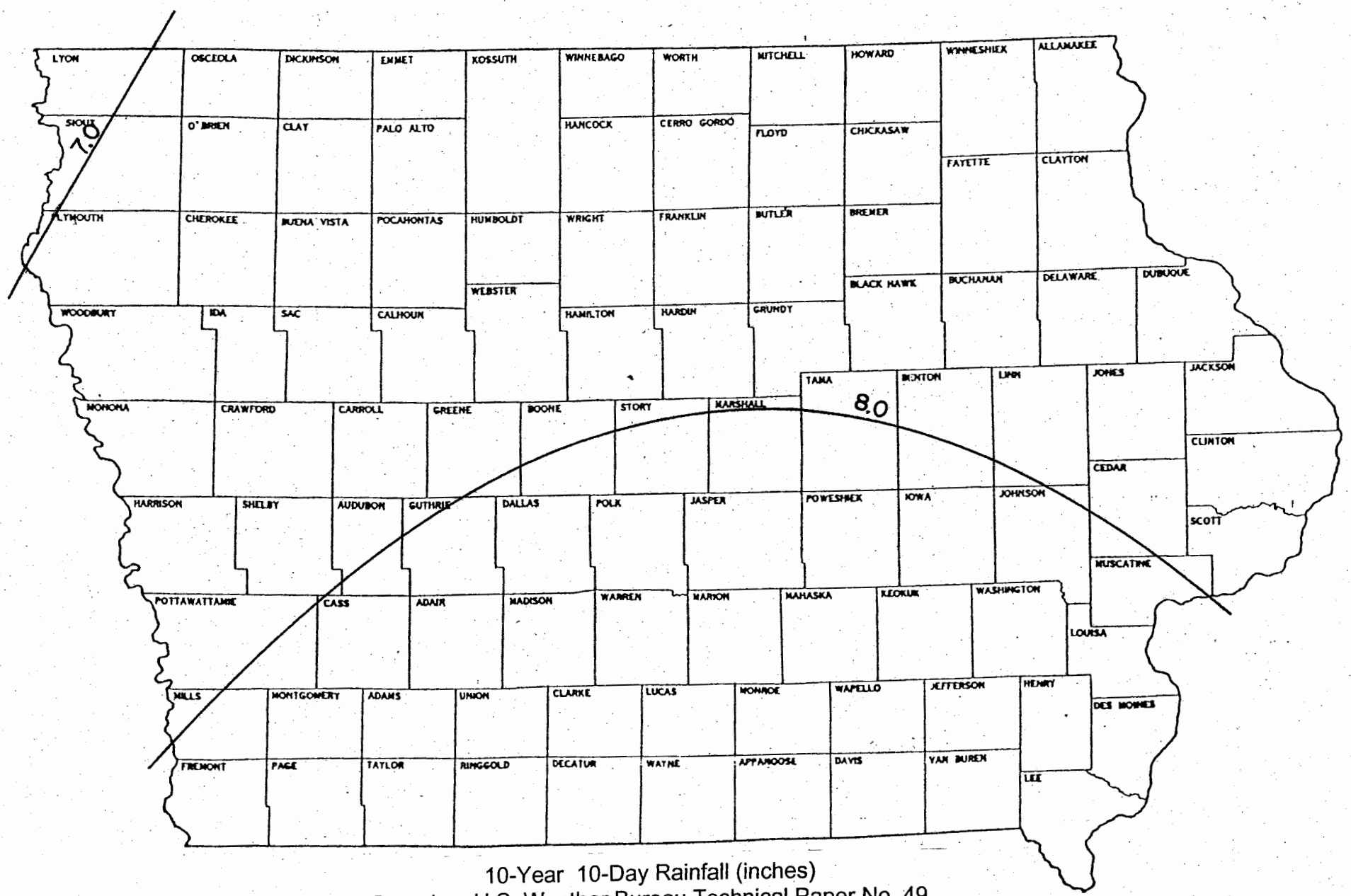
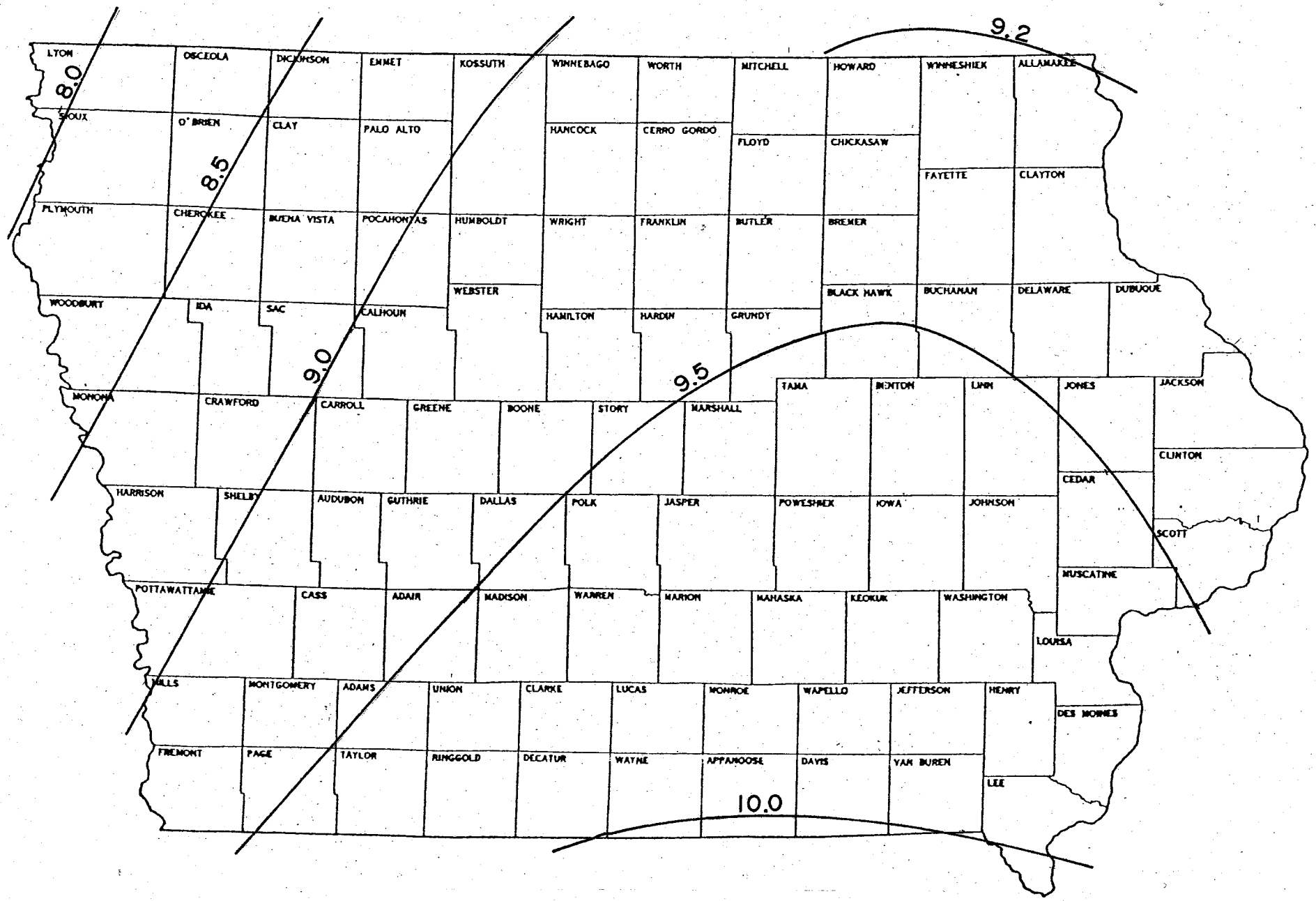
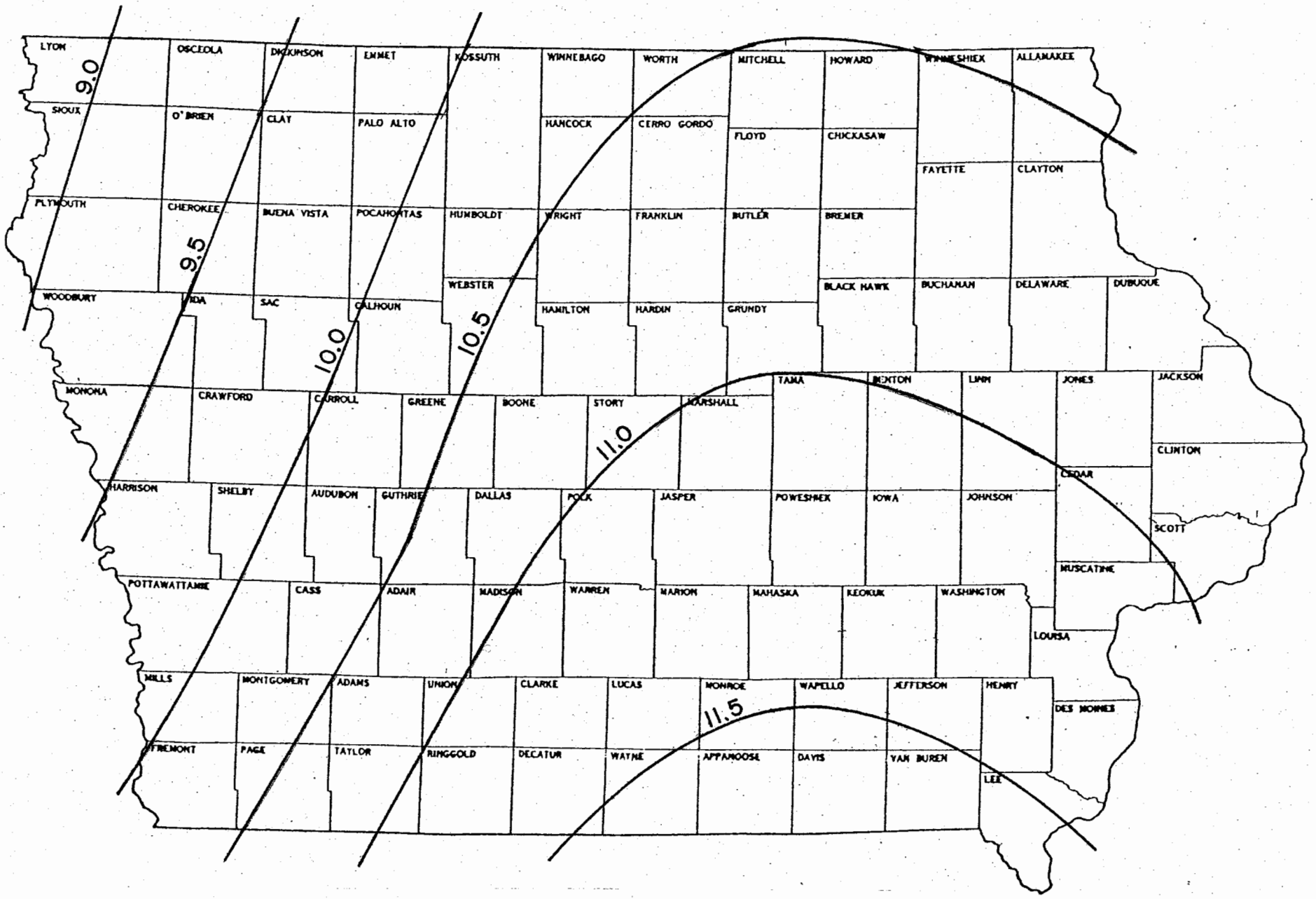


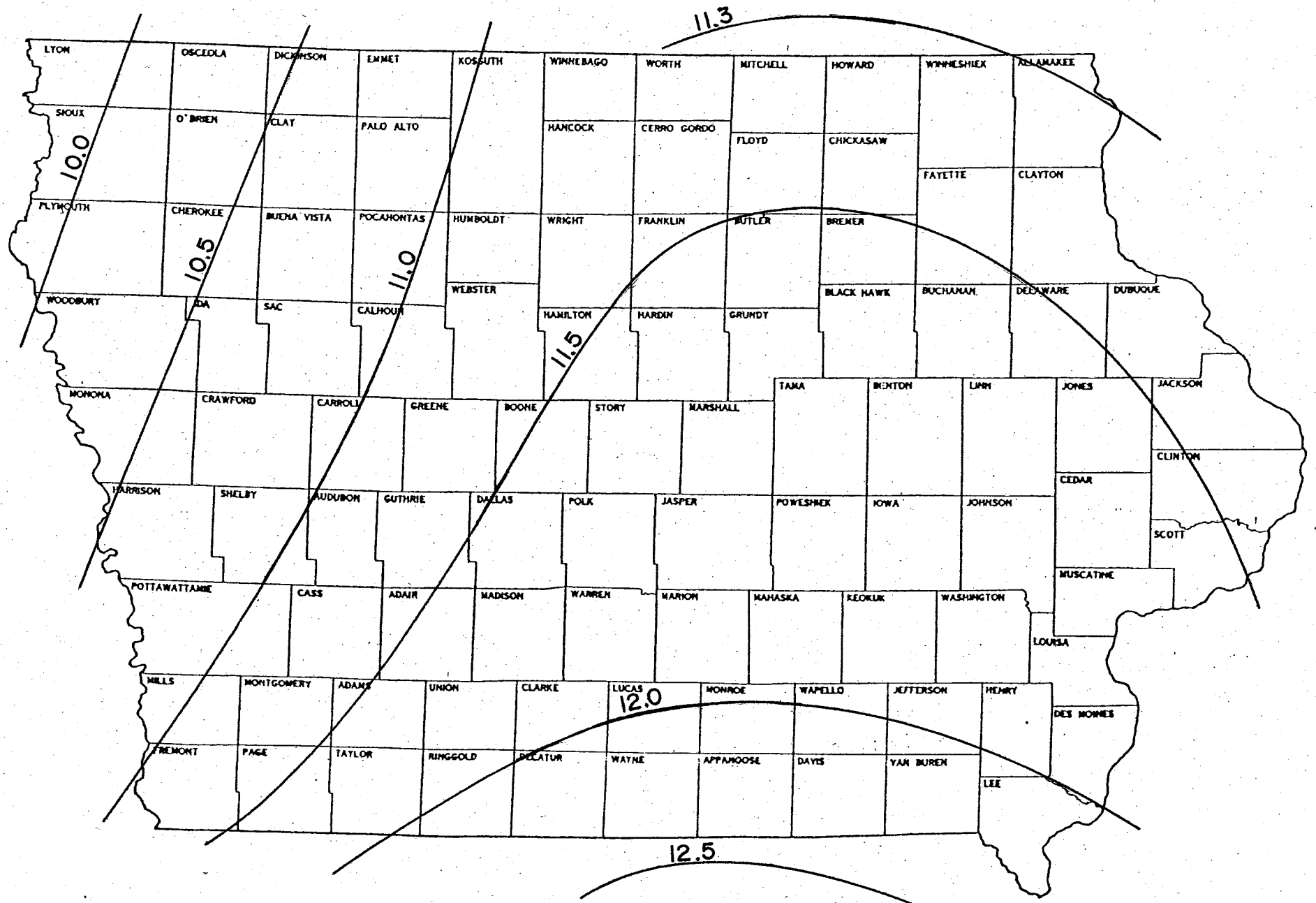
10-Year 10-Day Rainfall (inches)
Based on U.S. Weather Bureau Technical Paper No. 49



25-Year 10-Day Rainfall (inches)
Based on U.S. Weather Bureau Technical Paper No. 49



50-Year 10-Day Rainfall (inches)
Based on U.S. Weather Bureau Technical Paper No. 49



100-Year 10-Day Rainfall (inches)
Based on U.S. Weather Bureau Technical Paper No. 49